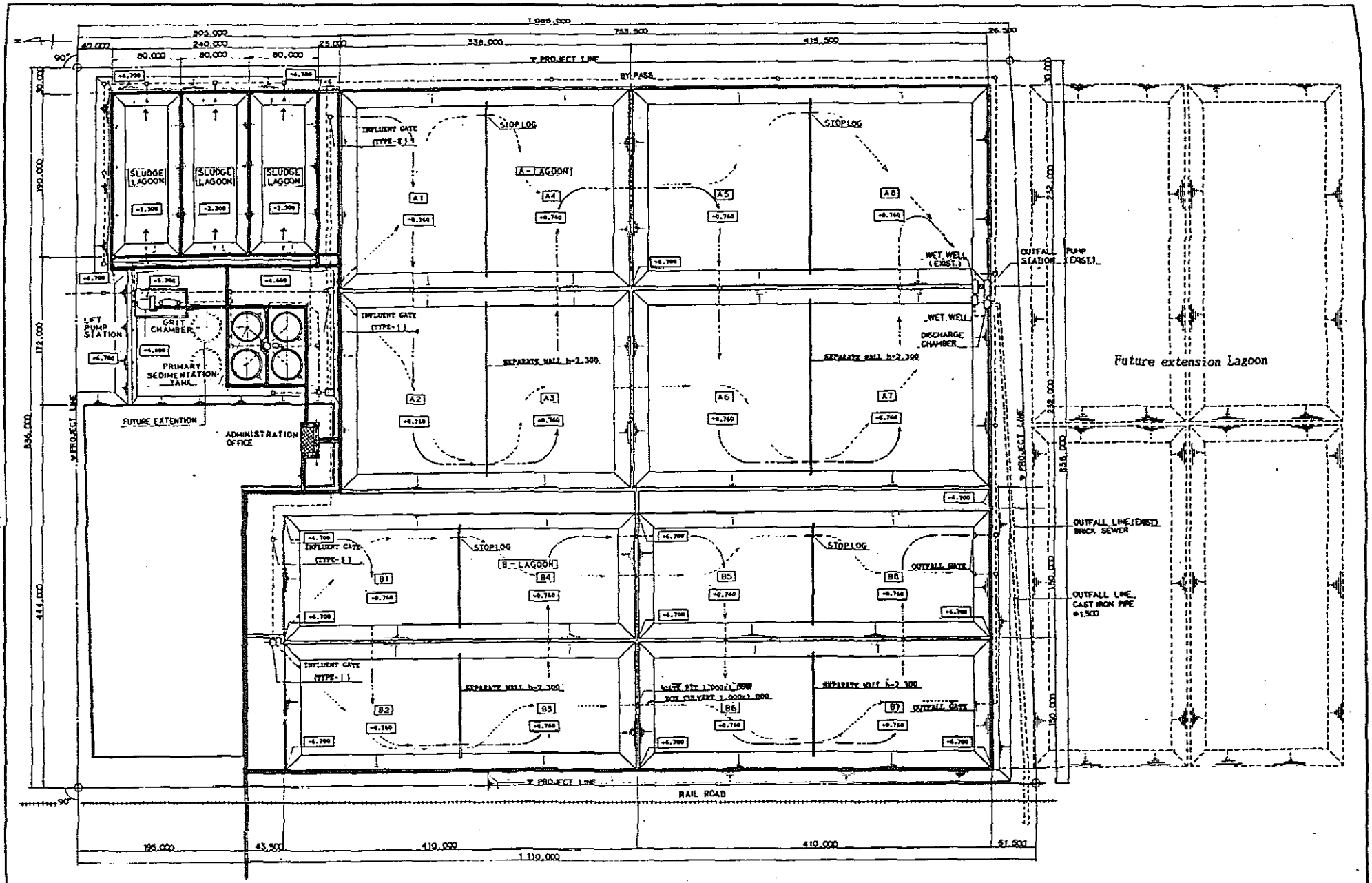
Items	Configuration/ Specification	Qty.	Remarks
Mechanical Bucket Machine		5	
Training		-	Three (3) Months
Ultra sonic flow meter		2	Portable type

The quantity of spare parts for each equipment shall cover two (2) to five (5) years respectively.

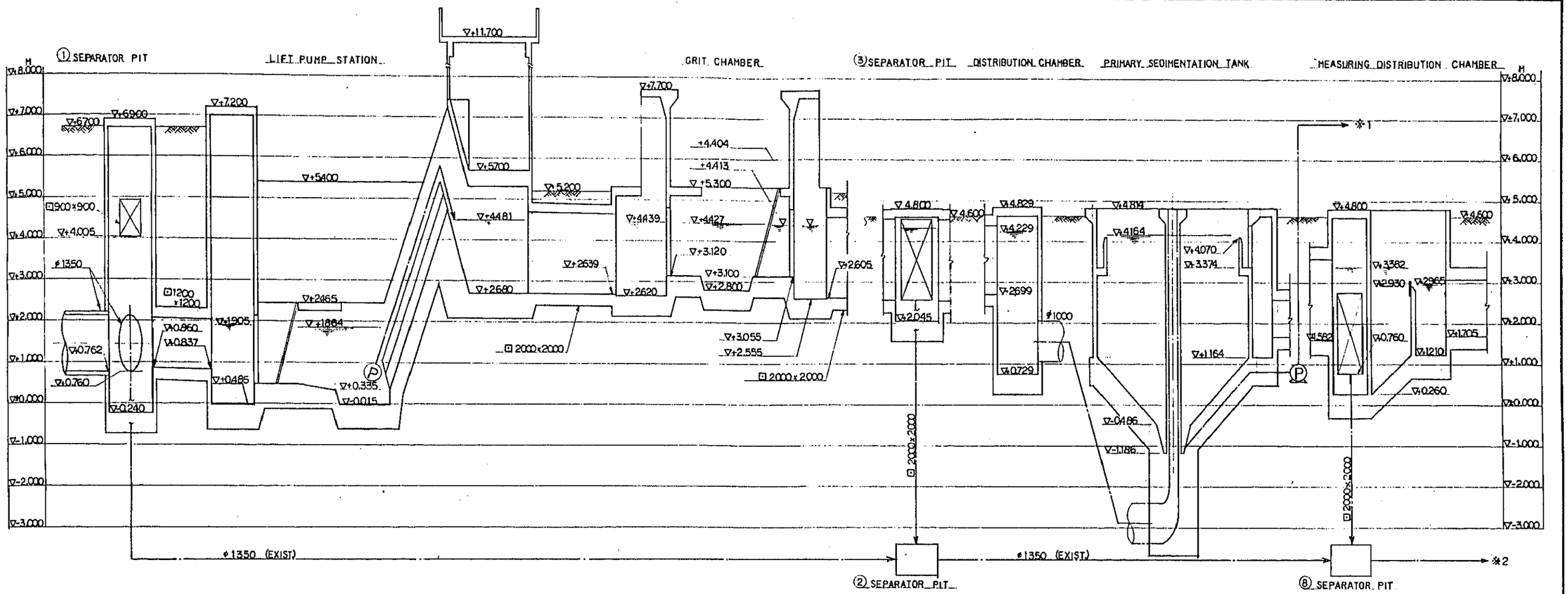
5.3.2 Basic Engineering Drawings

(Refer to the drawings on the next pages.)

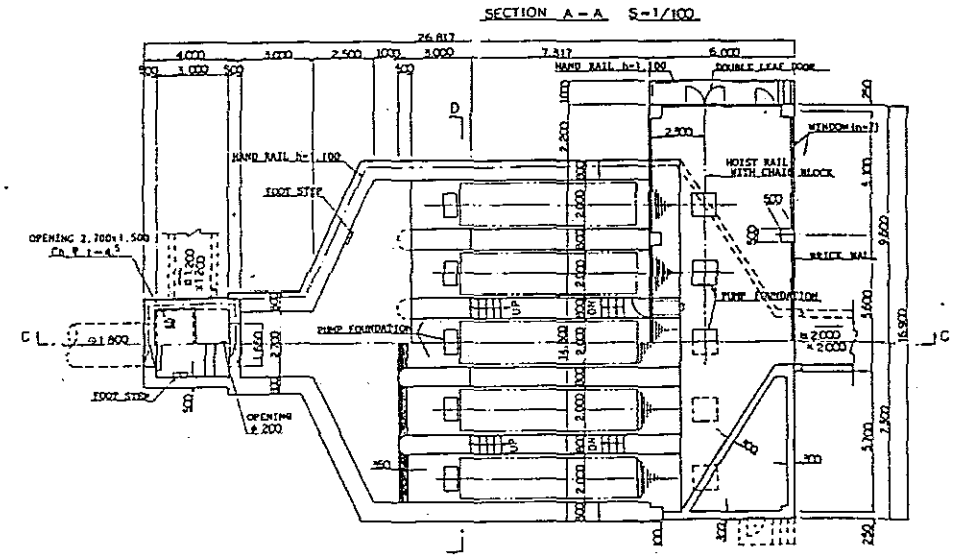


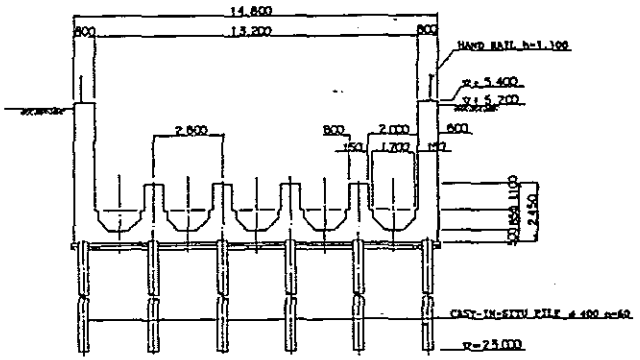
GENERAL PLAN S=1/2,000

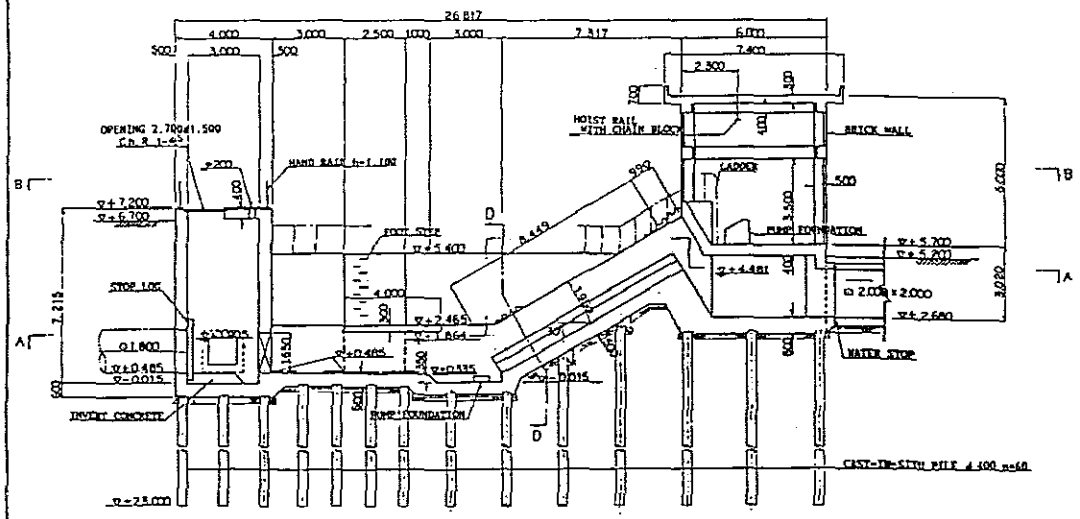
(1)-1 GENERAL PLAN



(1)－2 DRAWING FLOW SHEET OF WATER LEVEL

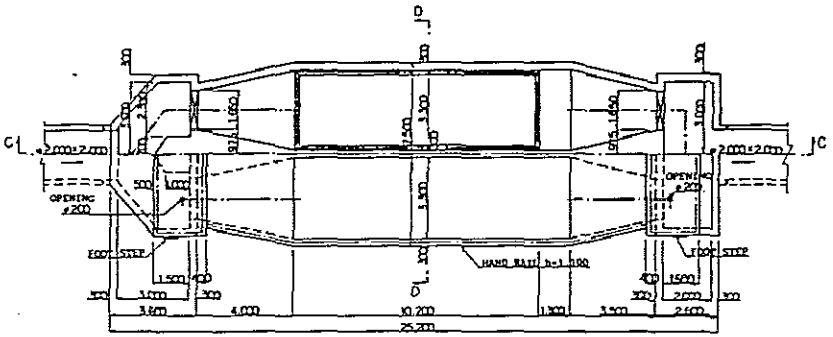




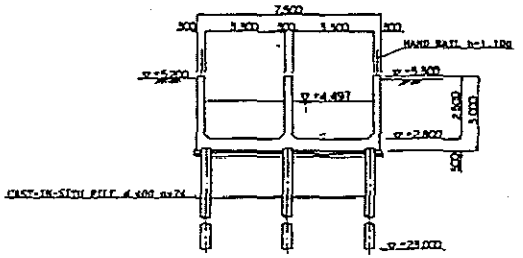


(2) LIFT PUMP STATION

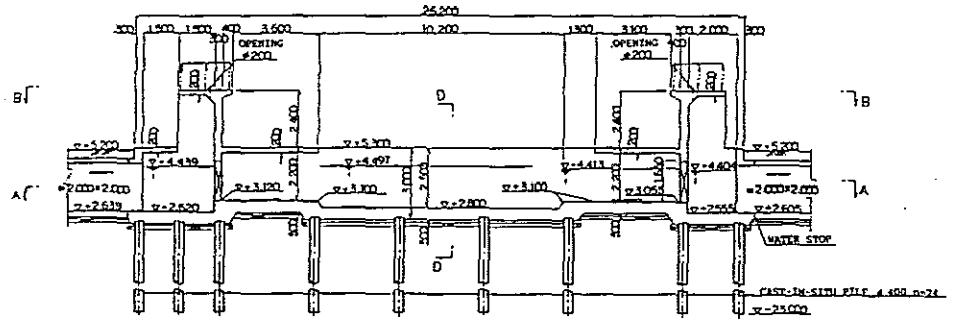
SECTION A-A S=1/100



SECTION B-B S=1/100

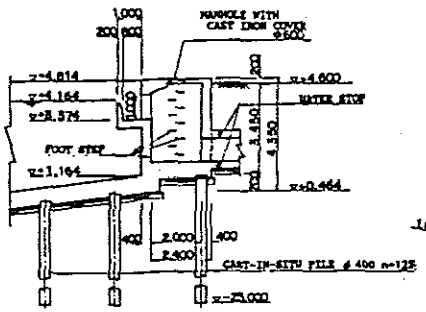


SECTION D-D S=1/100

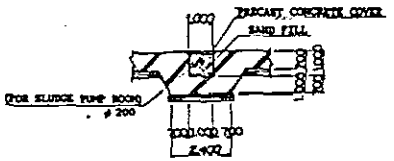


SECTION C-C S=1/100

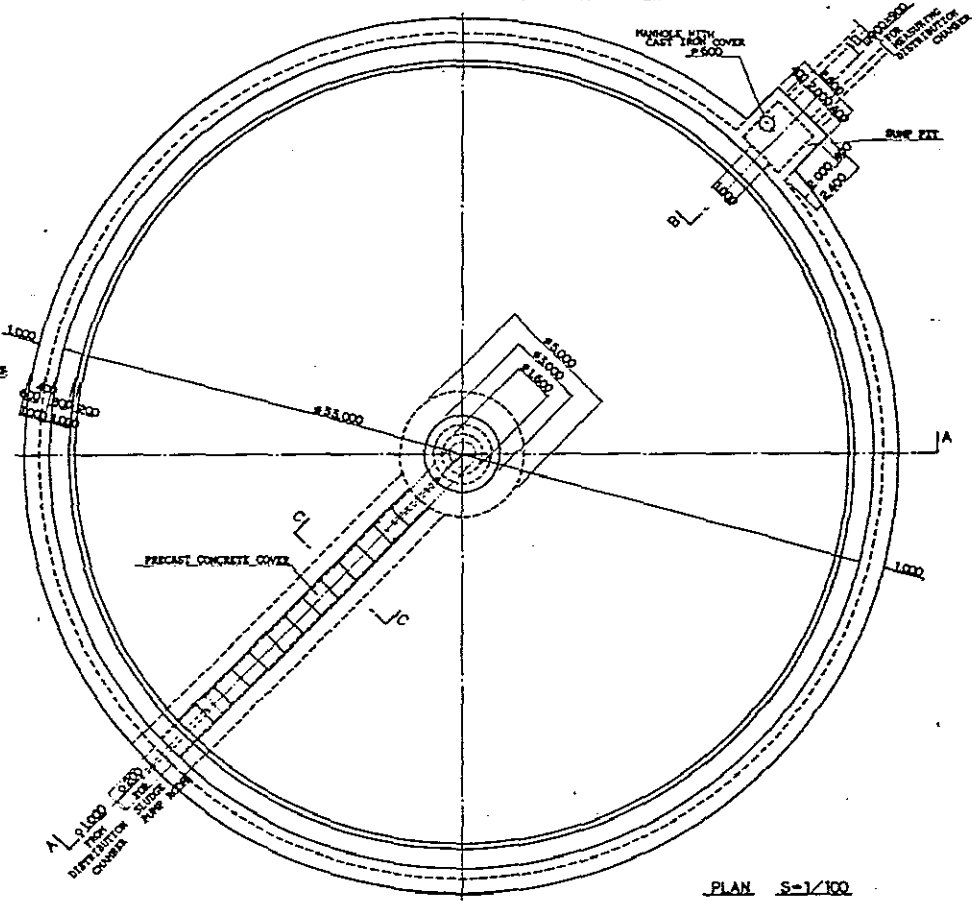
(3) GRIT CHAMBER



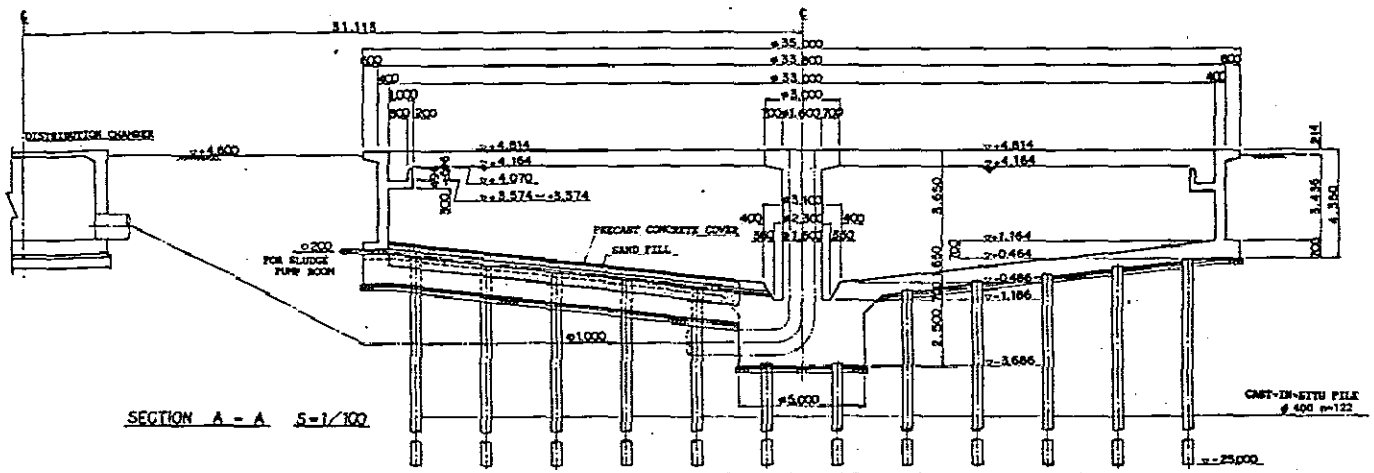
SECTION B - B S=1/100



SECTION C - C S=1/100

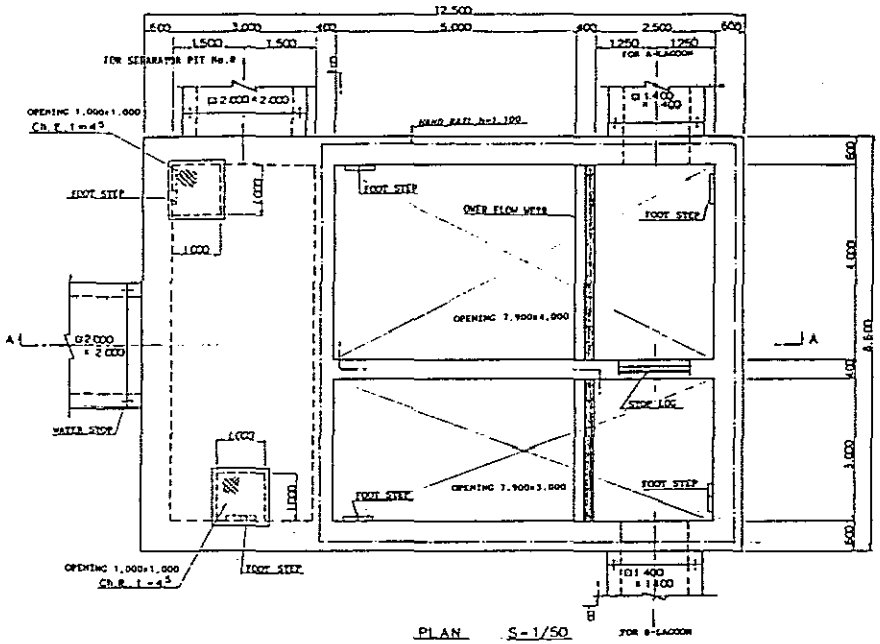


PLAN S=1/100

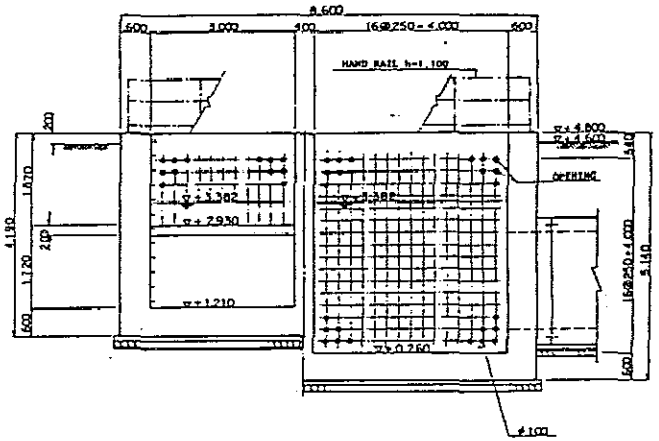


SECTION A - A S=1/100

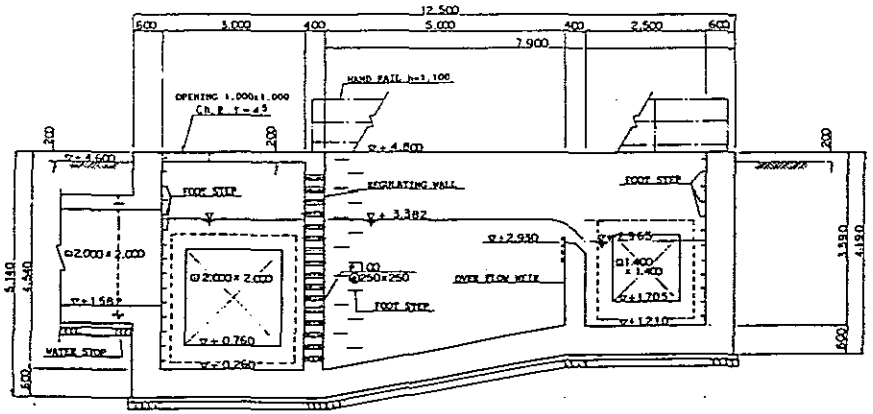
(4) PRIMARY SEDIMENTATION TANK



PLAN S=1/50

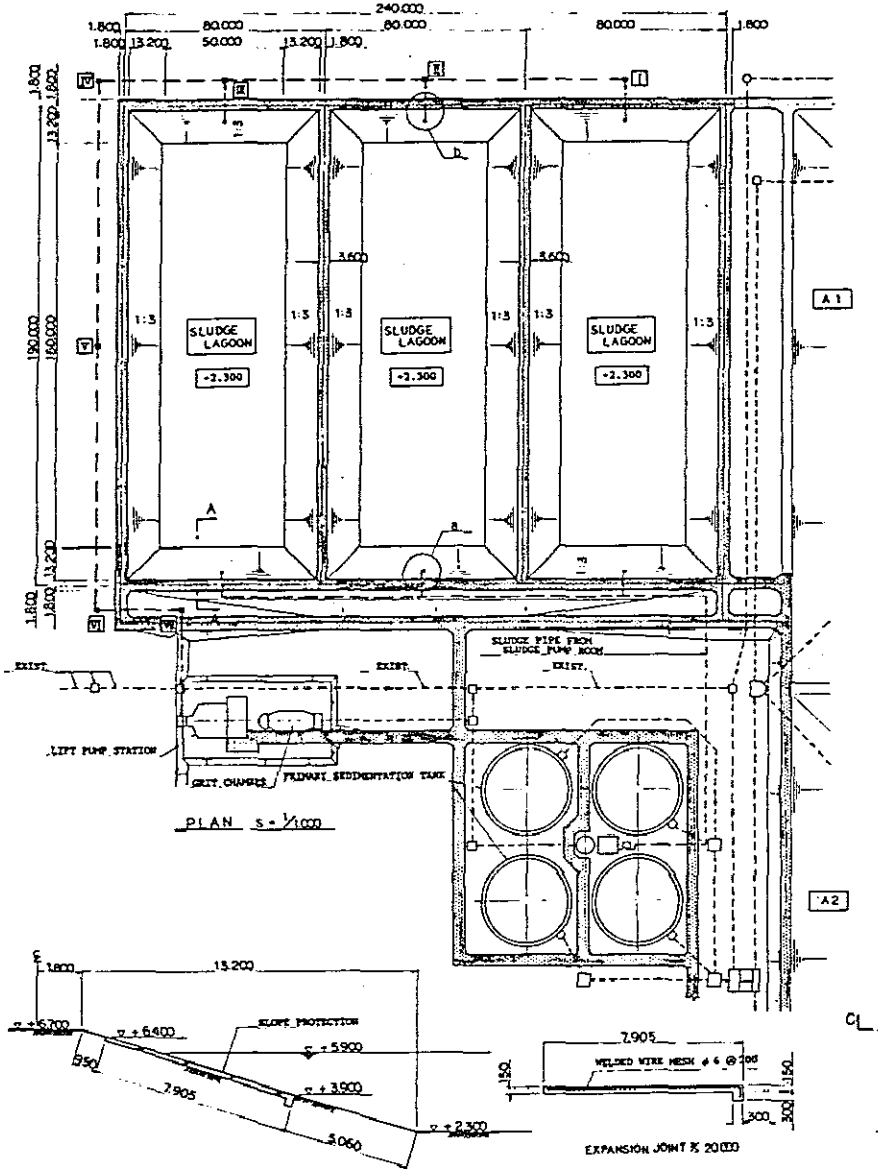


SECTION B-B S=1/50



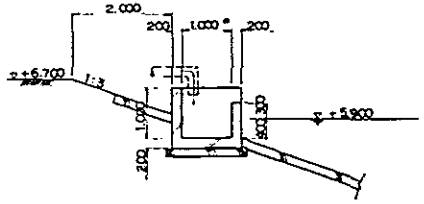
SECTION A-A S=1/50

(5) MEASURING DISTRIBUTION CHAMBER

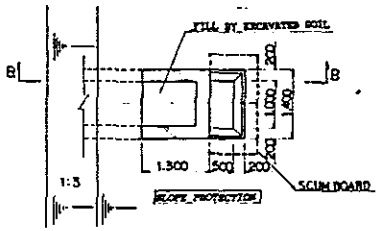


PLAN S = 1/1000

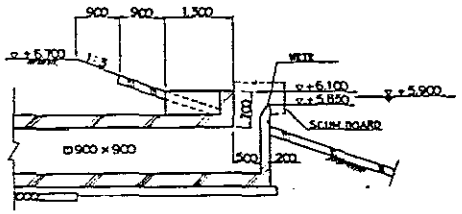
SECTION A-A S = 1/100 SLOPE PROTECTION S = 1/100



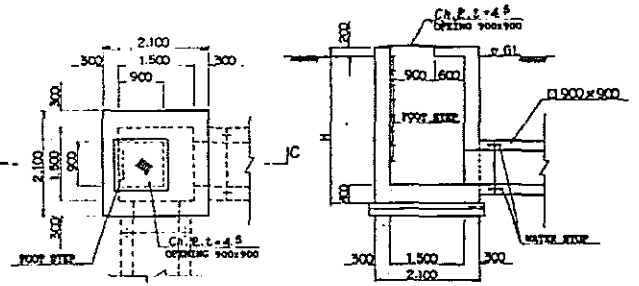
a DETAIL S = 1/50



b DETAIL S = 1/50



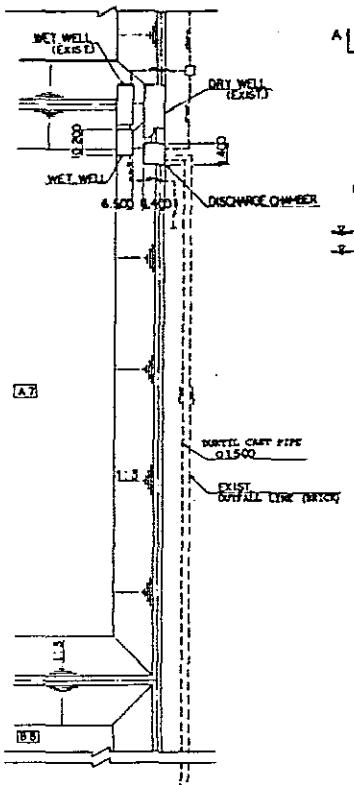
SECTION B-B S = 1/50

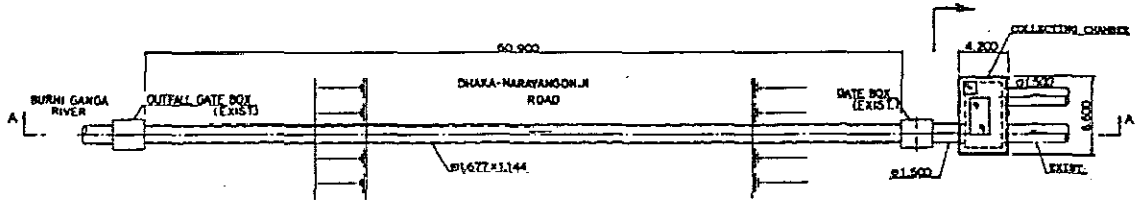


PLAN OF PIT SURROUNDING SLUDGE LAGOON S = 1/50 SECTION C-C S = 1/50

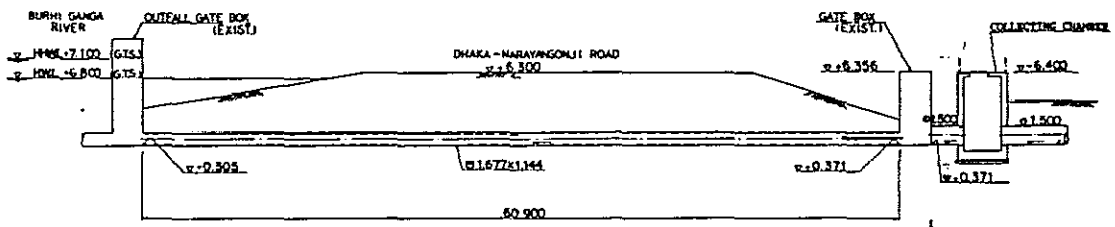
NO	GL (m)	H	NO	GL (m)	H
I	+ 6.700	2.915	V	+ 6.700	3.230
II	+ 6.700	2.995	VI	+ 6.700	3.335
III	+ 6.700	3.075	VII	+ 6.700	3.370
IV	+ 6.700	3.125			

(6) SLUDGE LAGOON



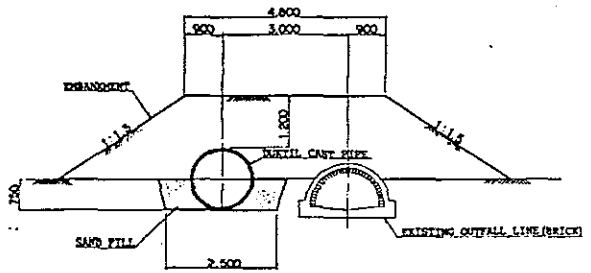


ROAD CROSSING SECTION S-1/200

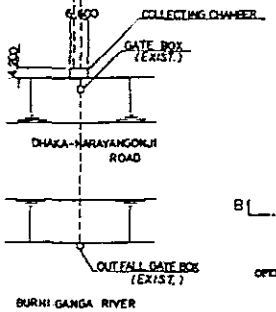


SECTION A-A S-1/200

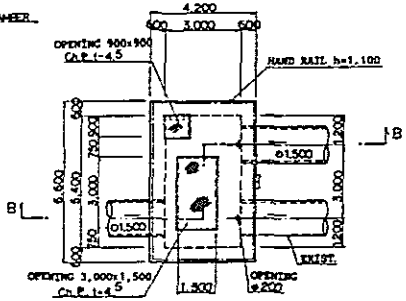
The scope of work in this project

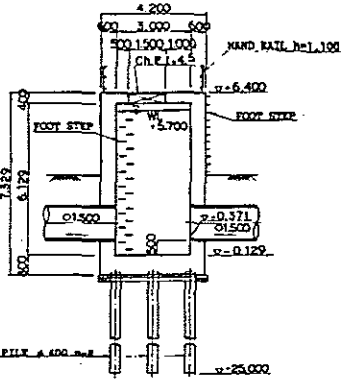


TYPICAL SECTION FOR GENERAL PART S=1/60



PLAN



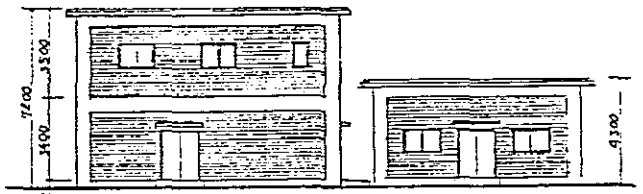


PLAN SECTION B-B

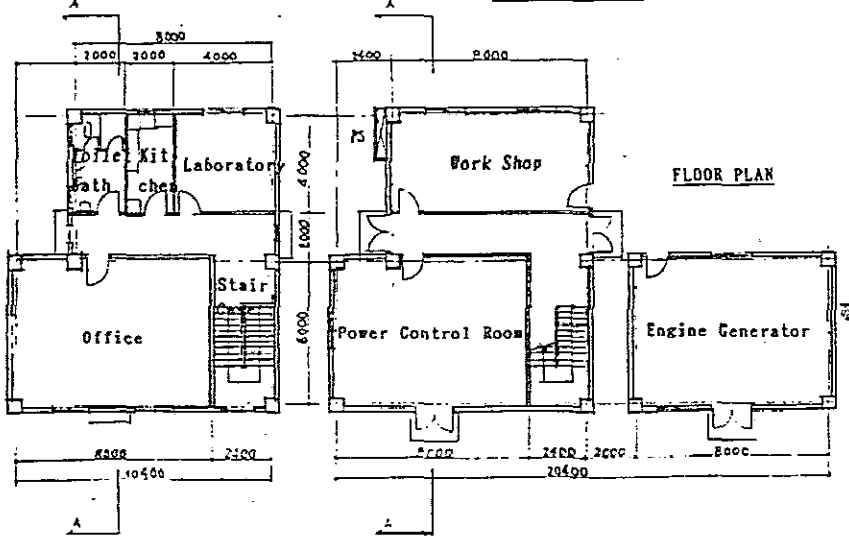
COLLECTING CHAMBER S=1/100

(7) OUTFALL PIPE

WEST ELEVATION

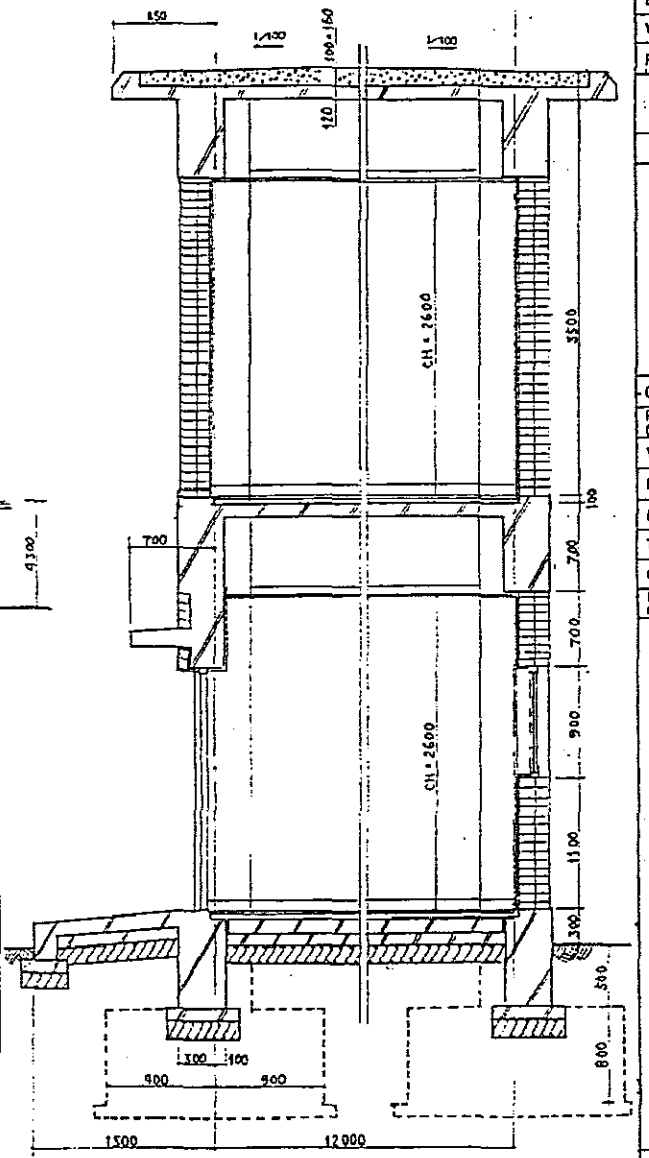


SOUTH ELEVATION



FLOOR PLAN

A-A SECTION DETAIL



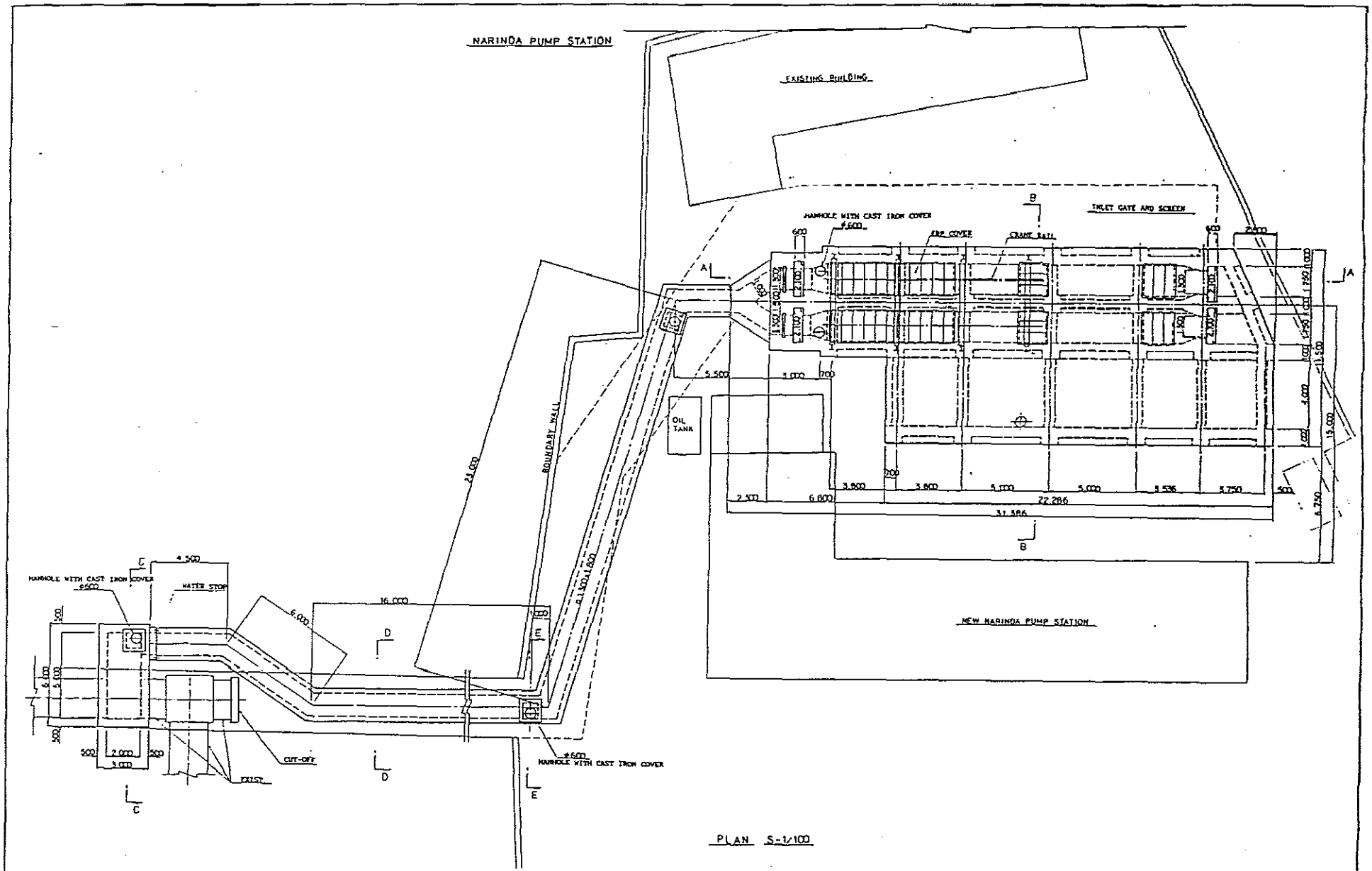
EXTERIOR FINISH SCHEDULE	
ELEMENT	FINISH TYPE
BASE	EXPOSED CONCRETE
WALL	FAIR FACED BRICK
ROOF	LIME CONCRETE WATERPROOFING

INTERIOR FINISH SCHEDULE

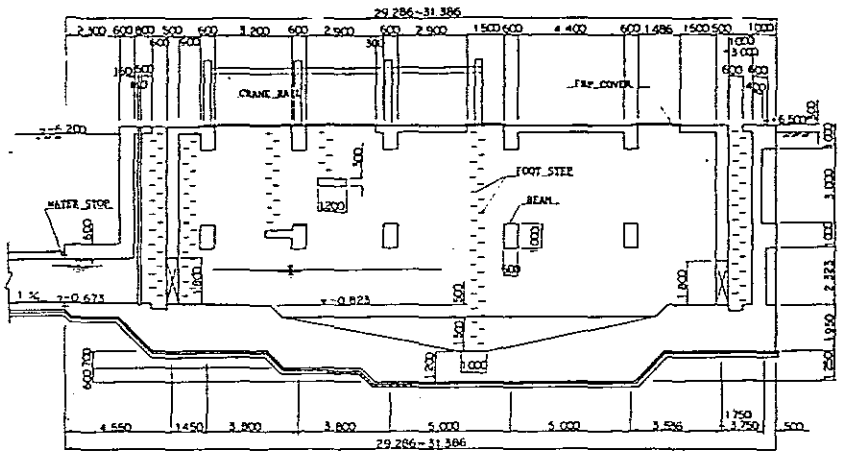
ROOM	FLOOR			BASE BOARD		WALL			CEILING			
	TERRAZZO TILE	CAST-IN-SITU TERRAZZO	TROWELED CONCRETE	TERRAZZO TILE H=100	TROWELED MORTAR H=100	E.P. ON PLASTER	V.P. ON TROWELED MORTAR	CERAMIC TILE	TROWELED MORTAR	SUSPENDED CEILING EP ON ACOUSTIC BOARD	SUSPENDED CEILING VP ON ACOUSTIC BOARD	EXPOSED CONCRETE
OFFICE	○			○		○				○		
POWER CONTROL ROOM	○			○		○				○		
WORK SHOP	○			○		○				○		
LABORATORY		○		○			○				○	
KITCHEN		○		○			○				○	
TOILET, BATH		○						○			○	
CORRIDOR	○			○		○				○		
ENGINE GENERATOR			○		○				○			○

PLAN A-1

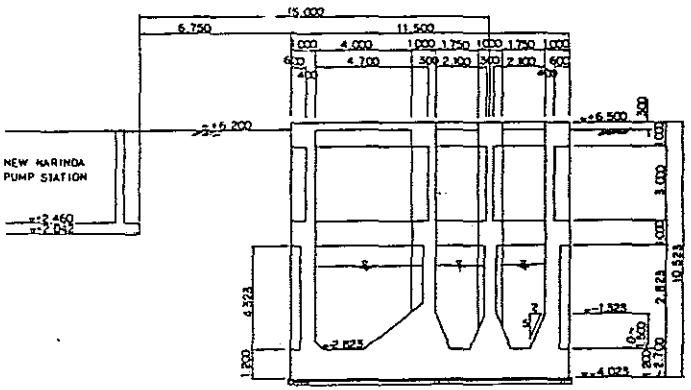
(8) ADMINISTRATION OFFICE



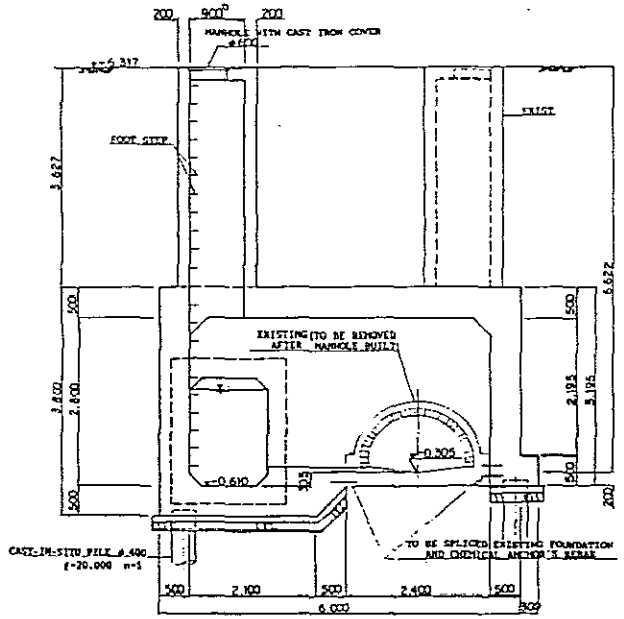
① NARINDA PUMP STATION (1)



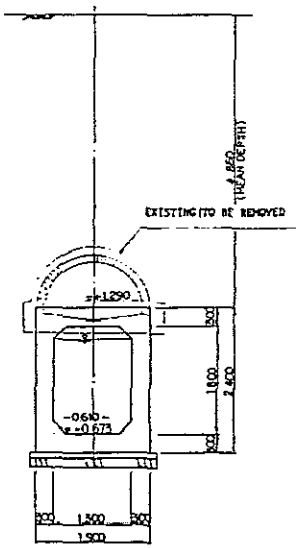
SECTION A-A S-1/100



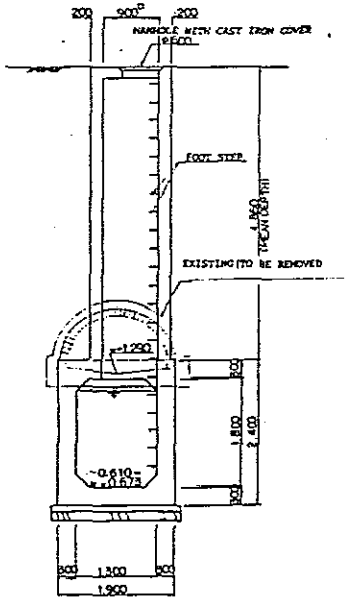
SECTION B-B S-1/100



SECTION C-C S-1/40



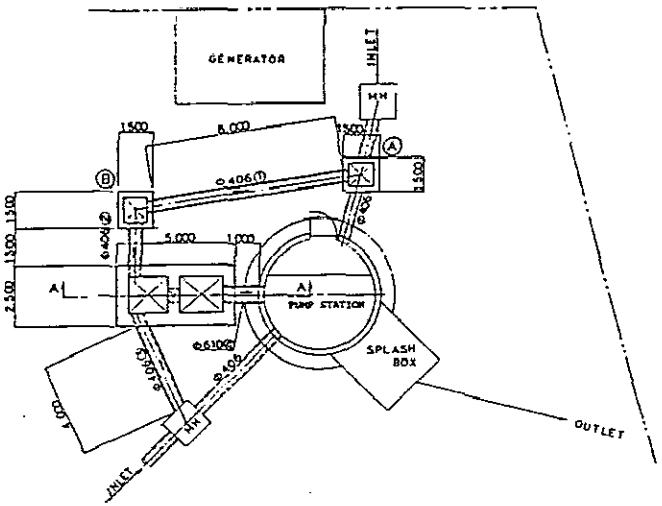
SECTION D-D S-1/40



SECTION E-E S-1/40

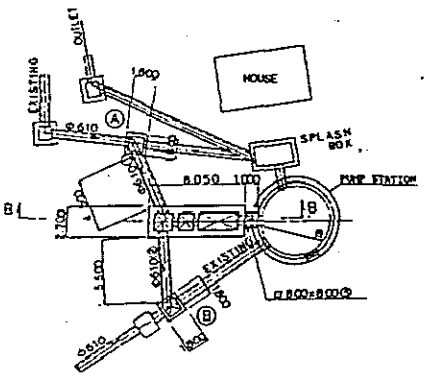
② NARINDA PUMP STATION (2)

ASAD GATE L.S.

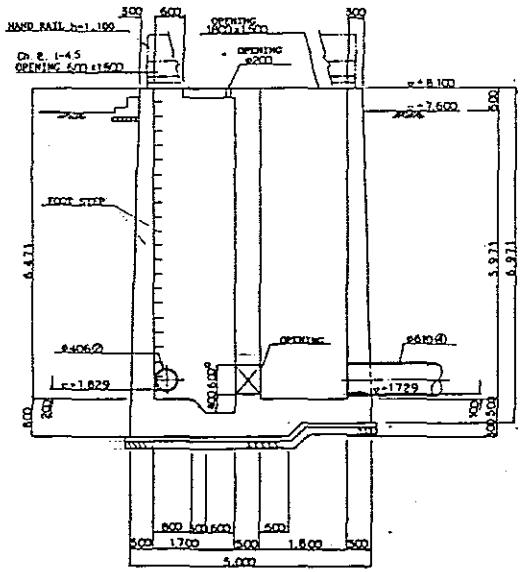


PLAN S-1/100

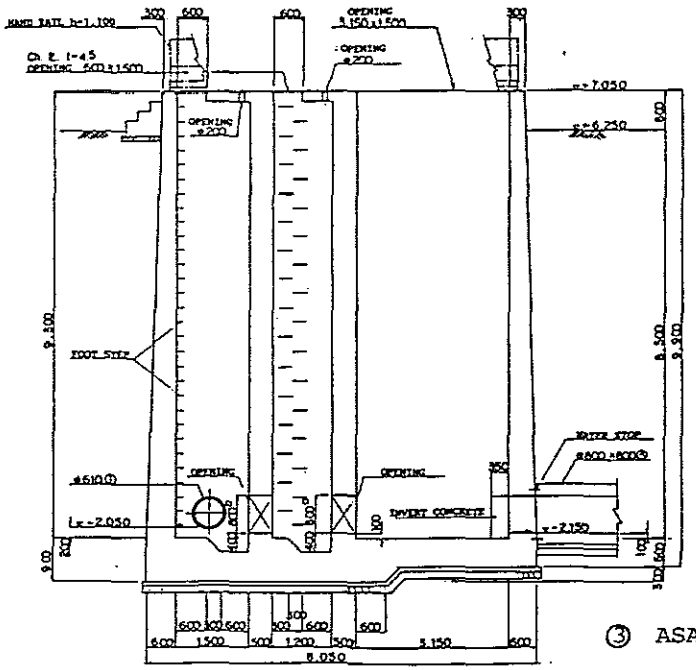
HAZARIBAG L.S



PLAN S-1/200



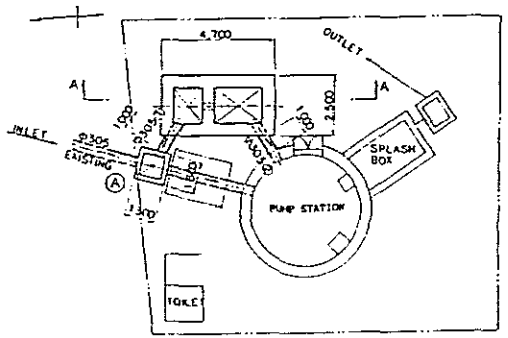
SECTION A-A S-1/50



SECTION B-B S-1/50

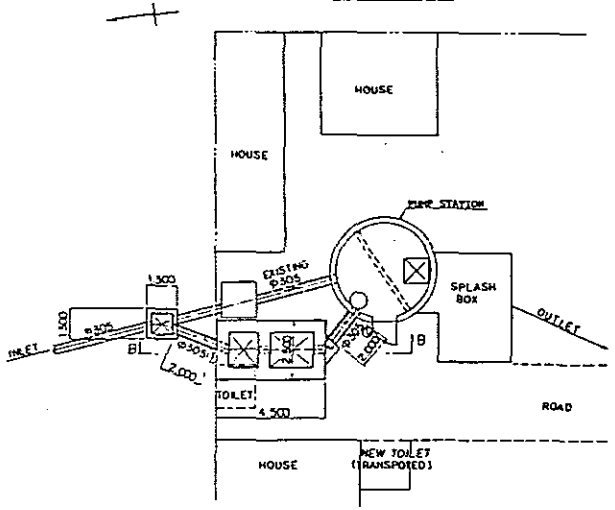
③ ASAD GATE L.S./HAZARIBAG L.S.

NAWABGANJ L.S.

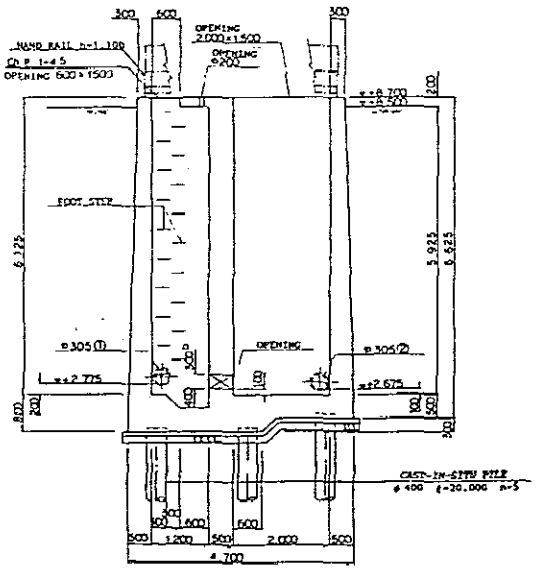


PLAN S-1/100

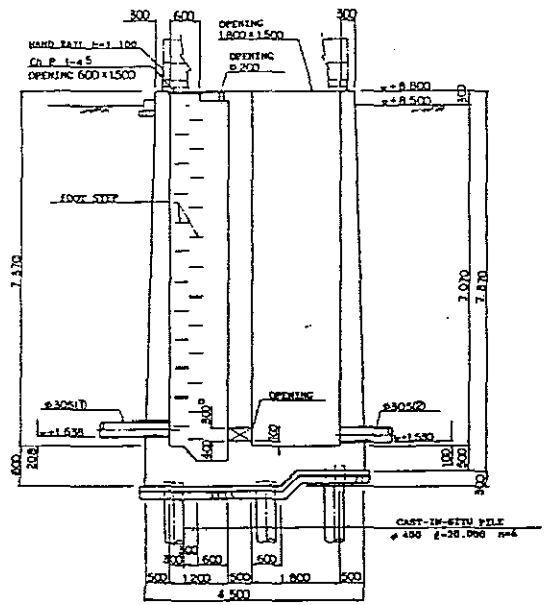
AZIMPUR L.S.



PLAN S-1/100



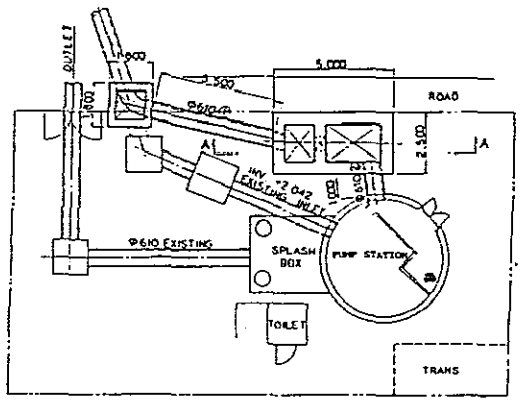
SECTION A—A S-1/50



SECTION B-B S-1/50

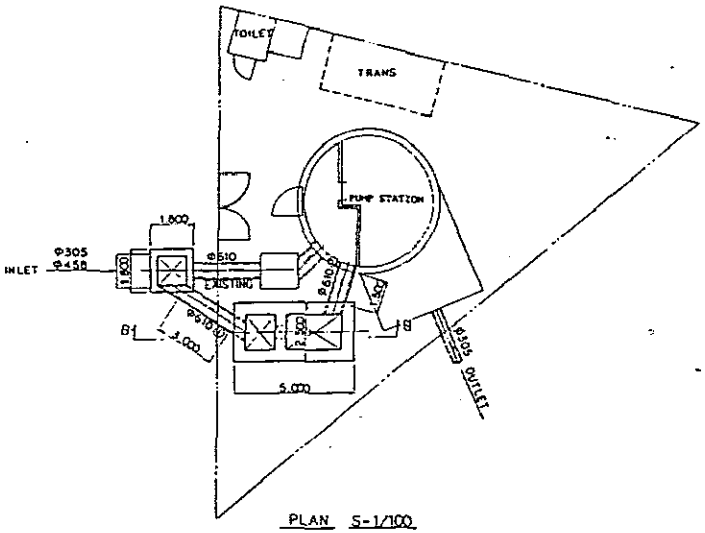
④ NAWABGANJ L.S./AZIMPUR L.S.

NEW MARKET L.S.

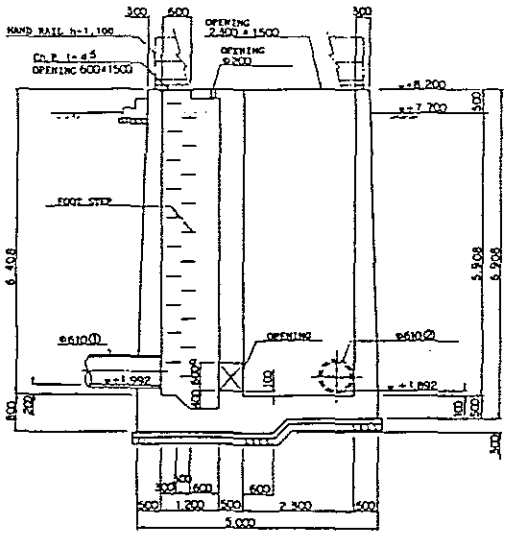


PLAN S-1/100

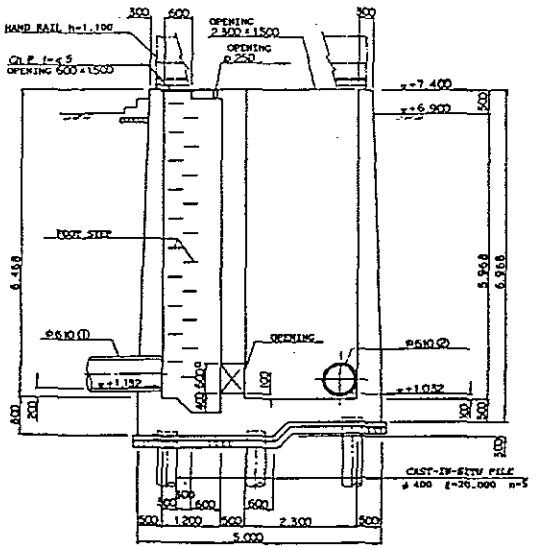
MEDICAL COLLEGE L.S.



PLAN S-1/100



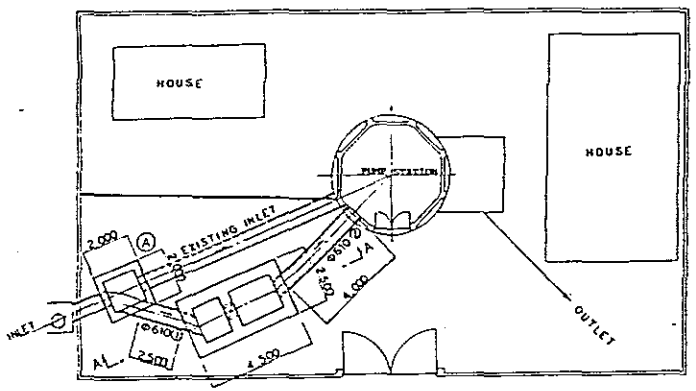
SECTION A-A S-1/50



SECTION B-B S-1/50

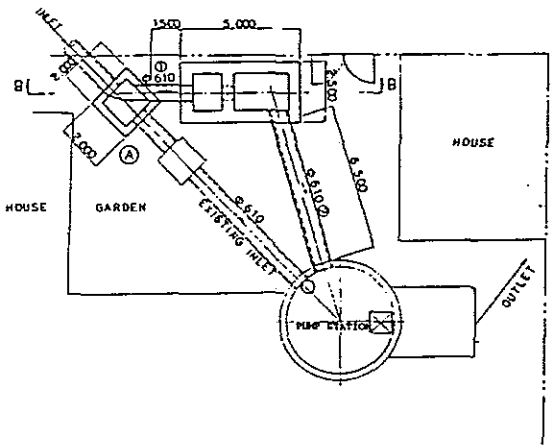
⑤ NEW MARKET L.S./MEDICAL COLLEGE L.S.

MOGHBAZAR L.S.

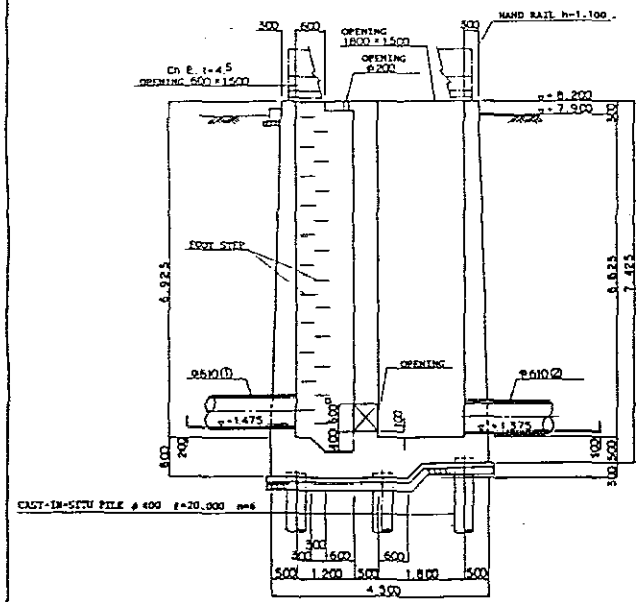


PLAN S=1/100

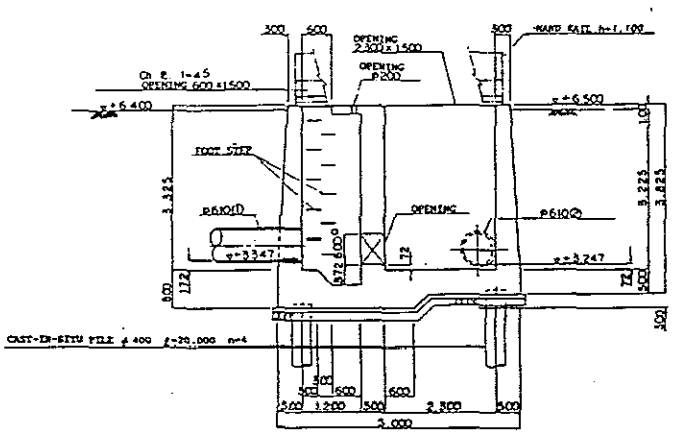
P & T L.S



PLAN S=1/100



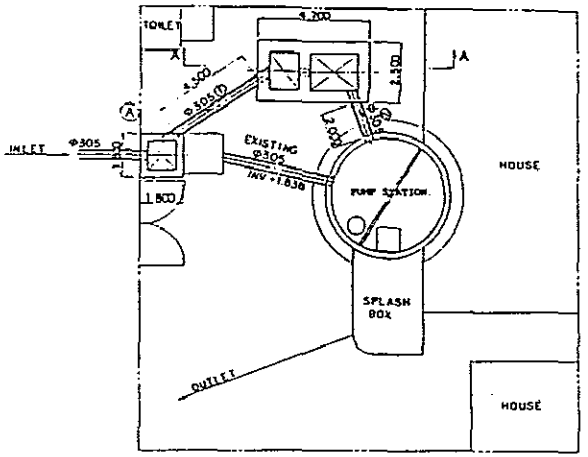
SECTION A-A S=1/50



SECTION B-B S=1/50

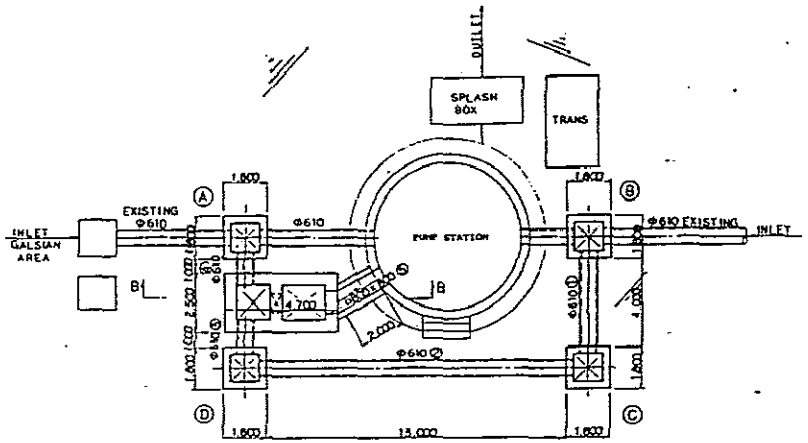
⑥ MOGHBAZAR L.S./P & T L.S.

FARIDABAD L.S.



PLAN S=1/100

TEJGAON L.S.



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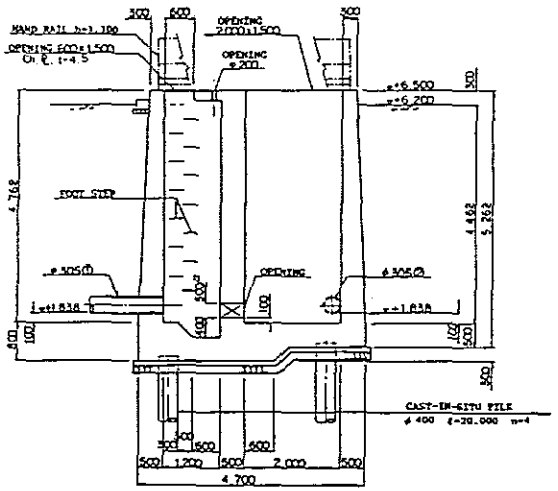
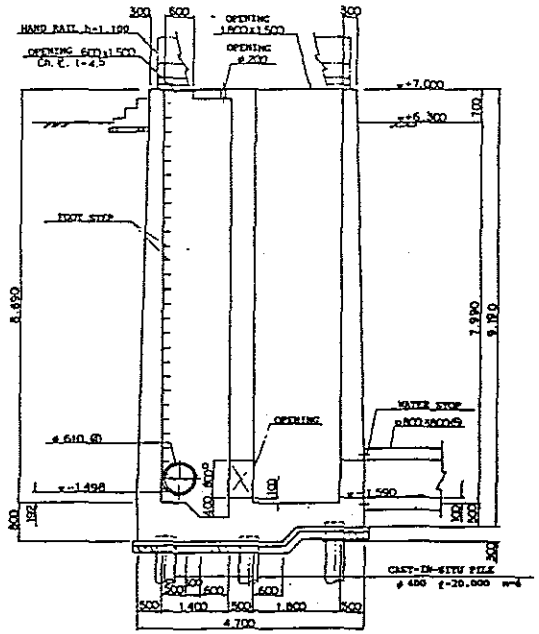


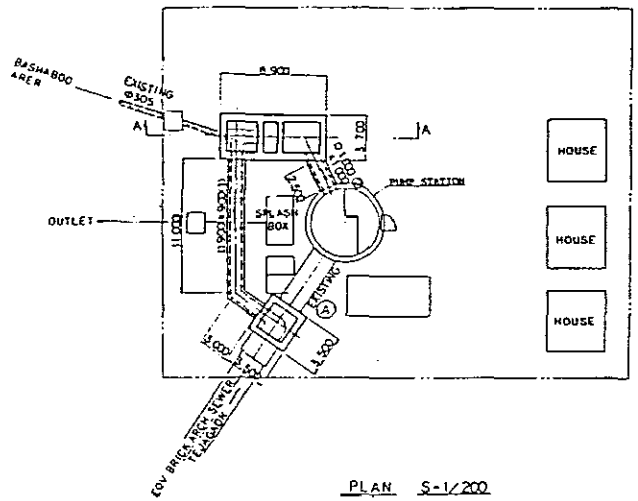
SECTION A—A S=1/50



SECTION B—B S=1/50

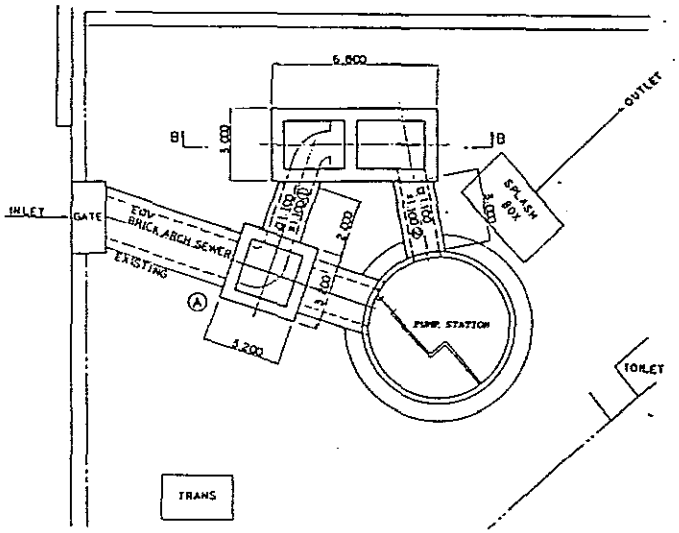
⑦ FARIDABAD L.S./TEJGAON L.S.

BASHABOO L.S



PLAN S-1/200

SWAMINBAG L.S



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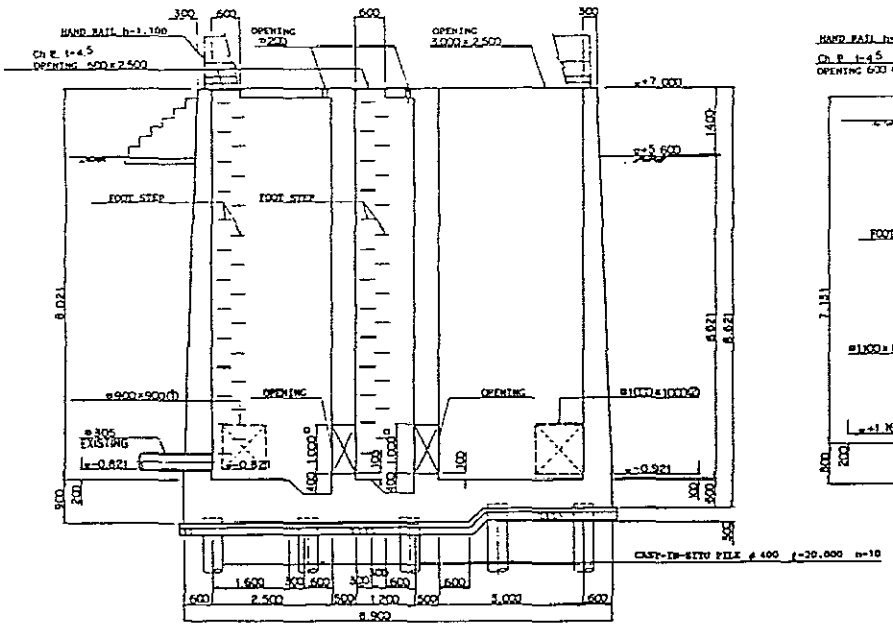
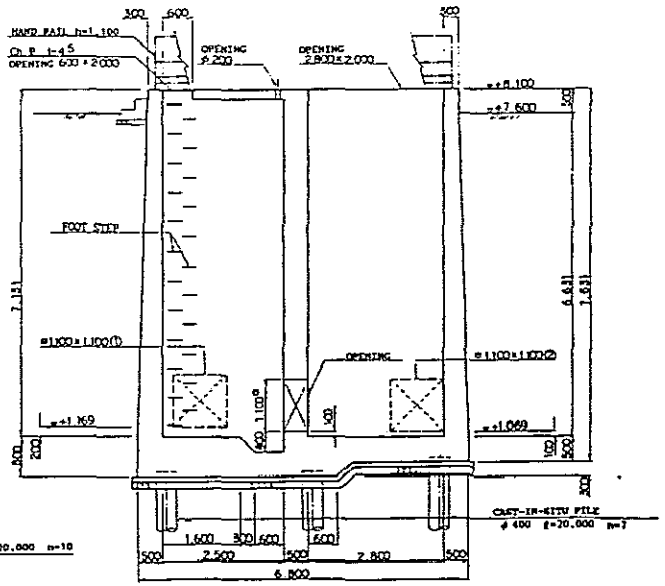


SECTION A-A S-1/50



SECTION B-B S-1/50

⑧ BASHABOO L.S./SWAMINBAG L.S.

6. Project Implementation Plan

6. Project Implementation Plan

6.1 Project Implementing Organization

The governmental agency of Bangladesh that is to take charge of this project is the Ministry of Local Government, Rural Development and Cooperatives. Dhaka WASA, subordinate agency of the ministry, is in charge of the project execution. Refer to the organizational chart.

Dhaka WASA is a public agency which takes responsibility for the pervasion of water supply and sewerage services and their management in the city of Dhaka. The head office is situated in the city with total personnel numbering 2,610. The administration is composed of chairman, and his subordinate chief engineer, a commercial manager, secretary, managers of some other departments, and the director of the training institute which is under the direct supervision of the chairman.

The chief engineer, manager of the engineering department is directly in charge of the project. Operation and maintenance of the facilities in this project will be commissioned to the respective zone offices after completion.

6.2 Assignation of Responsibilities

The tasks to be undertaken in this project which are to be responsibilities of Japan are the designing work relating to the improvement and expansion of the existing sewerage, civil work, piping work, mechanical and electrical work, the supply of sewer cleaning facilities and supervision of the work. On the other hand, Bangladesh shall take responsibility for the preparation of construction site and relevant infrastructure, in addition to the operation and maintenance of the facilities when completed.

The following shows the scope of the work for which the respective countries shall take responsibility.

(1) Japan's Scope of Work

1) Sewer System (including civil, mechanical and electrical facilities)

a) Pumps which are required as replacements for those installed in the lifting pump stations and the main pump station
b) Control panel of each pump
c) Some automatic operation device interlocked with level gauge
d) Influent screening facility of the lifting pump stations
e) Improvement of those sewers requiring urgent repair

2) Sewage Treatment System (including civil, mechanical and electrical facilities)

a) Sewage lifting pump
b) Primary sedimentation tank
c) Facultative lagoon
d) Modification of existing lagoon
e) Disinfection facility
f) Treated water outfall sewer

3) Auxiliary Facility and Others

a) Electric power distribution facility
b) Road construction in the treatment plant
c) Lifting pump station and control room of the treatment plant
d) Face finishing of the pump room of the lifting pump station and main pump station
e) Sewer cleaning facility
f) Instruction and training for the operation and maintenance of the constructed facilities

(2) Bangladesh's Scope of Work

1) Construction Site

a) Acquisition of land for the construction of facilities
b) Acquisition of land for the construction of maintenance road
c) Removal of unnecessary facilities remaining in the construction site, and ground leveling

2) Preparation of Relevant Infrastructure

a) Supply of electric power and water, connection of telephone communications line

Electric Power

Electric power, which is required to operate the pumps and other facilities of sewerage service systems, shall be supplied and connected to the power distribution boards which will be provided by Japan.

Water

Water supply equipment used in the administration office of the sewage treatment plant shall be extended to the boundary of the plant. Requirements for the equipment are as follows.

i)	Application	:	For drinking and other miscellaneous purposes
ii)	Piping Diameter	:	25 mm
iii)	Outlet	:	At the boundary of the treatment plant, valve shall be attached to the piping end. Water meter may be provided, as required.

Telephone

One telephone communications line covering the whole area of the city shall be provided in the administration office of the sewage treatment plant, together with one telephone handset unit and protective device.

b) Preparation of area for temporary project office (for WASA and the consultant)

c) Preparation of material storage area

3) General preparation and cleaning of sewers

4) Recovery of missing manhole lids

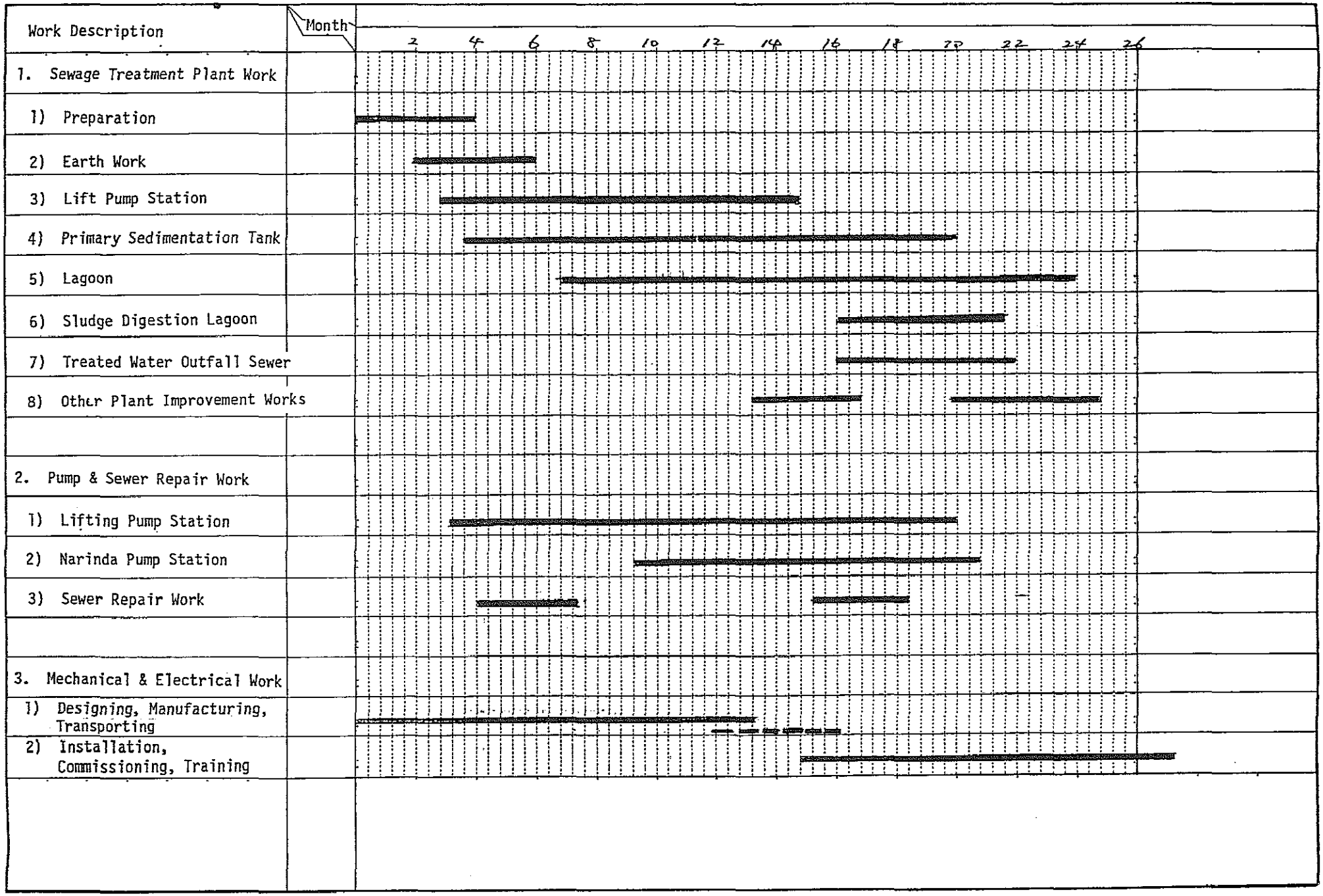
5) Operation and maintenance of completed facilities

6.3 Execution Plan

6.3.1 Work Execution Plan

In making a work execution plan of this project, it is required to take into thorough consideration the situation of the local construction industry. It is particularly important to give careful consideration to meteorological conditions, the procurement of construction materials and labor conditions. Table 6-1 shows a sample work schedule on the assumption that the work will start some time in the latter half of the rainy season.

Figure 6-1 : Sewerage Construction and Rehabilitation Works in Dhaka City Work Schedule



6.3.2 Implementation Schedule

The entire process of this project is divided into two phases; Detailed Design and Implementation Work.

For the Detailed Design phase, after the exchange of notes by the governments of Japan and Bangladesh, a consultant with Japanese nationality will enter into an agreement on the Detailed Design with the Government of Bangladesh before setting about the designing work.

When the engineering drawings and the work specifications required for Implementation Work, and the documentation required for bidding and the work execution contract are all prepared, documents on the Detailed Design will be submitted to the Government of Bangladesh for approval.

For the Implementation Work, after the exchange of notes on the project implementation by both countries, the aforesaid consultant will enter into an agreement on supervision of the work. Upon the approval of both governments, the consultant will invite prospective contractors bid. The appointed contractor shall enter into a contract on the Implementation Work with the Government of Bangladesh and apply for verification of the contract to the Government of Japan before undertaking the work.

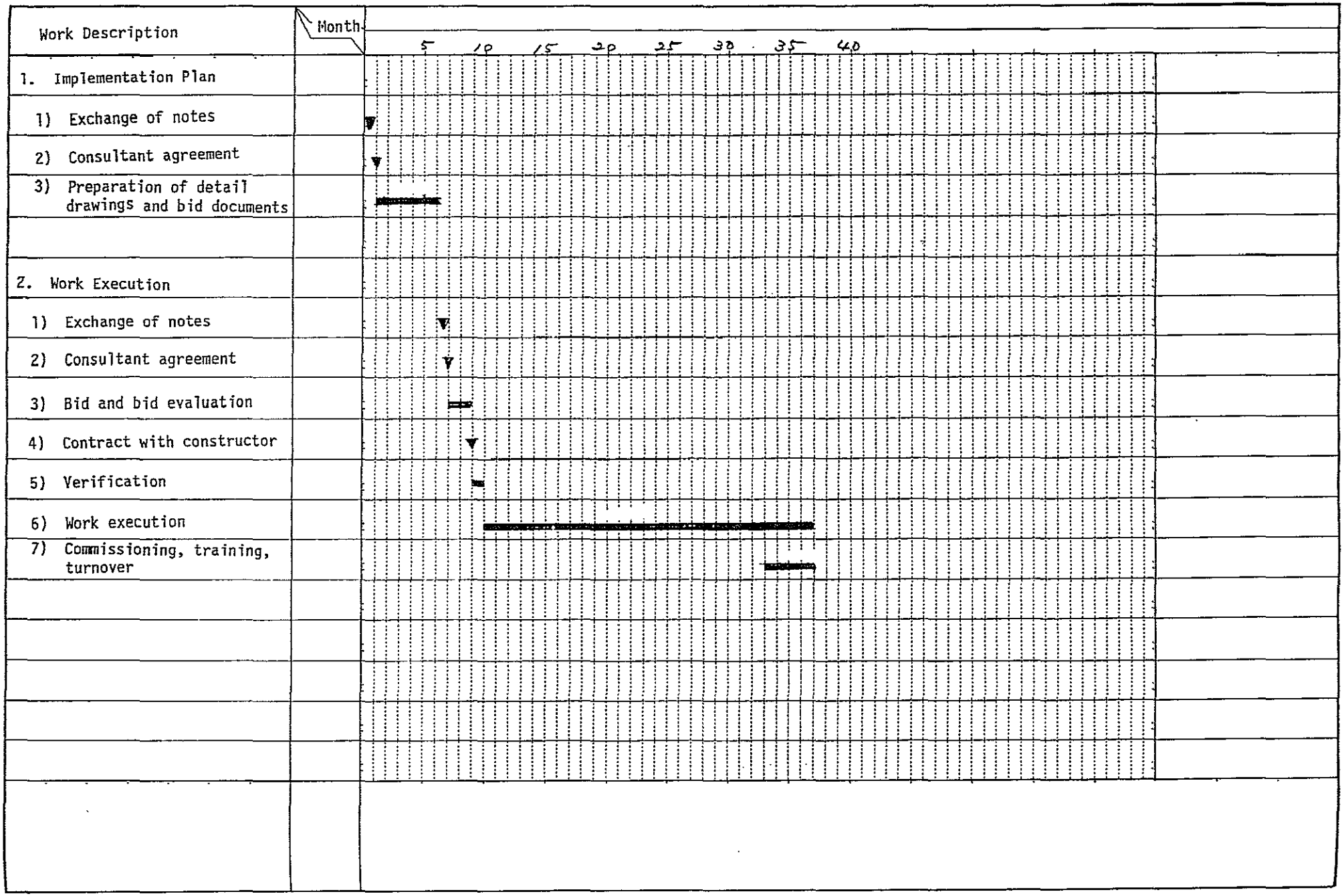
The Government of Bangladesh shall complete acquisition of the construction site, site leveling and all the other preparation work required in advance of the commencement of work, and take procedures for exemption from customs duties, sales taxes, as well as corporation taxes for the Japanese corporation so that the work may be started smoothly.

It will take about 5 months to make the Detailed Design while about 27 months are required for the Implementation Work. Accordingly, because of the difficulty of implementing the project as an ordinary grant aid project, it is necessary to carry it out as a national bond project.

With those matters mentioned above taken into consideration, the implementation schedule of the entire project will be as shown in Figure 6-2.

Figure 6-2

Work Schedule



7. Operation and Maintenance Plan

7. Operation and Maintenance Plan

7.1 General

The fundamental rules in the maintenance of sewerage are to effectively utilize sewer, pump station, treatment plant and other facilities in compliance with their purposes, to coordinate operation of these facilities to the level of their maximum performance in order to promptly dispose of the sewage, to treat the sewage properly and economically, and to maintain the quality of outfall water at a desirable level at all times. In exercising those rules, the personnel in charge of maintenance should have profound knowledge about the principle, the structure and the function of sewage treatment systems, and become familiar with proper operation and quality control so as to effectively operate the facilities in a coordinated manner.

7.2 Operation Plan

7.2.1 Lifting Pump Station

(1) Operation of Sewage Pump

In the operation of a sewage pump, it is a basic principle to discharge the influent sewage without delay in order to:

1) Avoid overflow from sewer manholes located in low lying areas; and
2) Prevent the sedimentation and precipitation of earth, sand, organic substances and other materials in sewers.

While, in principle, the pump is manually operated by the local control panel, it is necessary to constantly check the local visual level gauge for a proper water level, and adjust the level to that appropriate to the features of the pump station for continuous operation at the lowest possible level.

Even at night, in order to avoid a rise in the level, one or two pump units shall be put under automatic operation by level switch.

When trouble takes place in the pump, a movable submersible pump shall be set at the influent gate or in the screen pit to maintain the lifting capacity as much as possible.

(2) Maintenance of Screen and Grit Chamber

Screened grit and debris shall be removed as early as possible to minimize the difference in the level before and after the screen and to prevent the influent level from going up too high.

For the grit chambers of Narinda Pump Station, the sedimented sand shall be removed by vacuum car or manually, as required, for

cleaning. Although 2 grit chambers will be provided and both of them will be in service under normal conditions, during sand cleaning either one shall continue operating while the other is shut down. In order to prevent the putrefication of organic sediments and the outflow of sand to the pump well due to excessive congestion, the sand shall be checked regularly and the cleaning work shall be conducted periodically.

As the removed sand, grit, debris and other screened matters may generate odor, it is desirable to remove them from the station immediately for proper treatment.

7.2.2 Pagla Sewage Treatment Plant

(1) Lift Pump

As in the case of the lifting pump station, the pump shall be operated manually on the site by checking the visual level gauge. In this instance, to prevent any damage to the existing sewers from Narinda Pump Station and Swaminbag Lifting Pump Station, the pump shall be operated at the lowest possible level to avoid excessive pressure on the sewer. Even at night when the influent decreases markedly, continuous operation of the pump is recommended.

(2) Grit Chamber and Screen

The operation shall be exercised in the same manner as in the lifting pump station.

(3) Primary Sedimentation Tank

The sludge scraper shall be operated continuously. The raw sludge vacuum pump of the primary sedimentation tank shall be available for both manual mode with switch button and automatic mode with timer.

A bypass pipeline shall be provided from the primary sedimentation tank to the river to allow the outfall of primary treated water to deal with any excessively large volume of influent coming in particularly on rainy days. Vacuumed sludge will be charged into sludge lagoon for digestion treatment and sun-drying before it is taken out of the plant for disposal.

(4) Facultative Lagoon

The depth and the flow rate shall be properly adjusted to meet the treatment condition. In order to prevent the generation of odor and the growth of vermin, the bank surrounding the lagoon shall be kept free from terrestrial plants and hydrophyte.

The lagoon shall be emptied periodically (once every 2 to 3 years) for sun-drying and taking out the sludge. As excessive accumulation of sludge will generate odor and deteriorate the quality of treated water, the depth of sludge shall be measured regularly for timely removal.

(5) Disinfection Facility

The treated water will be sterilized by chlorine gas. The injection rate shall be adjusted manually depending on the quality treated.

(6) Measurement of Treatment Volume

The influent flow rate shall be measured by the measuring bank of the distribution chamber provided between the primary sedimentation tank and the lagoon.

(7) Water Examination

Simple examination of treated water can possibly be carried out even by the lay personnel of the plant while those analyses requiring professional knowledge will be entrusted to external laboratories.

7.3 Personnel Distribution

Operation and maintenance of existing facilities are managed by the MODS Circle of Dhaka WASA.

(1) Pump Station

The current number of operators distributed to pump station is as follows.

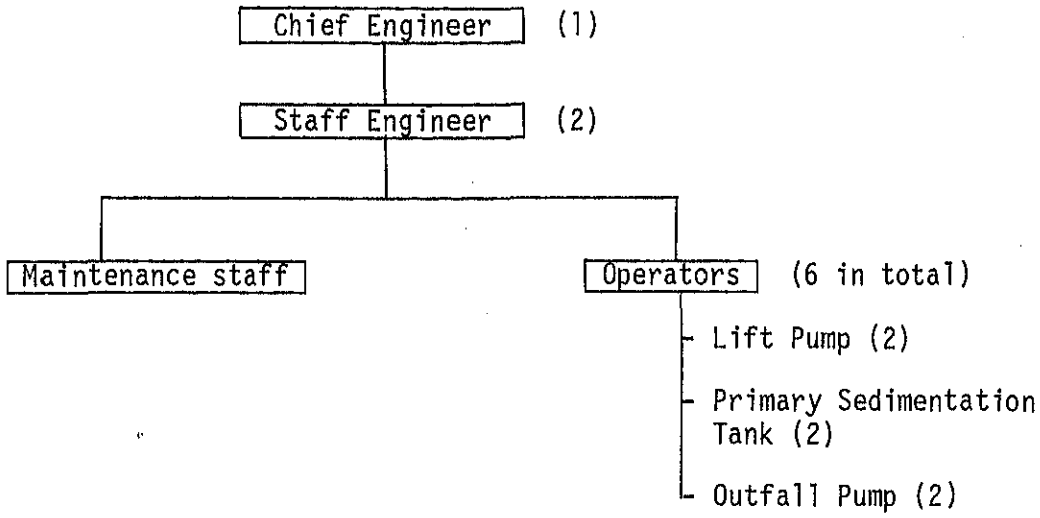
Each lifting pump station: 2 to 3 operators
Narinda pump station : 47 operators

Increasing the number of the operator may not be necessary even after the completion of this construction and rehabilitation project.

(2) Pagla Sewage Treatment Plant

Including the clerks in charge of financial and other general affairs, 43 personnel are at present assigned to the treatment plant. While a training session will be provided for the operators both in the construction phase and in the commissioning phase, it is desirable, if possible, for the present operators to receive such training so that the current work force can be maintained.

This project requires at least the following number of operators.



While the above number of personnel is a minimum requirement, the administrator is expected to form a proper working force to meet particular conditions.

7.4 Running Cost

7.4.1 Operation and Maintenance Cost

The running cost calculated in this study is limited to those relating to utilities such as electricity and chemicals. Labor cost, repair cost and other general expenses shall be separately taken into account.

1) Lifting Pump Station

On the basis of the influent flow rate specified in Section 4.2.2.3).(4) 'Determination of Pump Capacity of Lifting Pump Station', electric charges were estimated as in the following.

(Unit: 1,000 TK/annum)

Pump Station	Electric Charges
Asadgate	80
Tejgaon	500
Bashaboo	570
Swaminbag	600
Hazaribag	400
New Market	230
Mogbazar	140
P & T	190
Nawabganj	140
Azimpur	80
Medical College	50
Faridabad	110
Narinda	2,280
Total	5,370,000 TK/year

Note: Unit charge is in accordance with the PDB's tariff (August, 1987); 2.1 TK/kwh.

2) Pagla Sewage Treatment Plant

Calculation was made for the facilities planned in this project.

Qdmax : 120,000 m^3/day (rainy season)
Qdmean: 96,000 m^3/day (dry season)

Electric Charges

New equipment including lift pump, etc.	:	1,500,000 TK/annum
Existing outfall pump	:	780,000 TK/annum
Chlorine Disinfectant	:	340,000 TK/annum
Total		2,620,000 TK/annum

Total electric charges of the lifting pump stations and the treatment plant will reach 6,300,000 TK/annum. As shown in the preceding section 2.3.2 'Administrative System', Dhaka WASA's electric charges of the year 1986 were 10,027,000 TK in their annual expenditure. This amount includes the electric charges of offices and administration facilities.

7.4.2 Comparison of Electric Power Consumption

Electric power consumptions at present and after the implementation of this project are calculated.

Case 1: Electric power consumption at present

Based on the operation data of each pump station between 1986 and 1987 shown in Fig. 4-18, annual electric power consumption is calculated.

Case 2: Estimated electric power consumption after improvement executed by this project

It is expected that the electric power consumption at Hazaribag, New Market, Faridabad and Narinda pump stations as well as at Tejgaon and Swaminbag pump stations will increase immediately after execution of this project. The figure for Pagla Sewage Treatment Plant is the estimated annual electric power consumption based on the assumption that the operation is carried out corresponding to the influent sewage.

Case 3: Calculation of annual electric power consumption is made on the assumption that the improvement of the existing sewers is conducted by Bangladesh side and that Pagla Sewage Treatment Plant is operated to treat the amount of sewage set forth in this plan (Rainy season: 120,000 m^3/day).

Calculation of the annual electric power consumption for the above 3 cases is shown in the table below.

Table 7-1: Comparison of Electric Power Consumption

(Unit: 10^3 KWH/Year)

Case		Case 1	Case 2	Case 3
Treated water (m^3/day)	Dry	About 55,000	About 65,000	About 96,000
	Wet	About 80,000	About 99,000	About 120,000
Lift Station and Pumping Station (Ratio)		1,220*1 (100)	1,670*1 (137)	2,560 (210)
Pagla STP	Lift Pump	-	440	530
	STP	-	120	140
	Outfall Pump	340*2	300*2	370
	Sub Total (Ratio)	340 (100)	860 (253)	1,090 (321)
Total (Ratio)		1,560 (100)	2,530 (162)	3,650 (234)

*1: The power ratio is larger compared to the water ratio in Case 2. This is because the output of the motor at Hazaribag lifting pump station is larger than those at other lifting pump stations.

*2 The power consumption in Case 2 is smaller than that in Case 1 since the period allowing outfall by natural downflow is longer due to strengthening of the outfall pipe by this project.

8. Project Evaluation

8. Project Evaluation

8.1 Effect of the Project

The sewerage of Dhaka City has been expanded along with the population increase since its first construction in 1923. However, superannuation of old facilities has become very noticeable these days. This project aims at the rehabilitation of those superannuated facilities and the expansion of the treatment plant.

Sewerage is one of the indispensable basic infrastructures in contemporary urban life and it plays an important role to a great extent in maintaining a comfortable living environment for the residents. The effective utilization of existing facilities and the recovery of proper functioning of the sewerage system, when achieved by this project, will contribute greatly to improvement of the living environment of the citizens of Dhaka City.

8.2 Validity of the Project

Design capacity of the sewage treatment plant is 40 IMGD (183,000 m^3/day) according to the request from Bangladesh. However, the results of investigations reveal that the current sewage flow rate to the plant may reach 116,000 m^3/day while the maximum actual lifting quantity is in the range of approximately 90,000 m^3/day.

It is assumed that discharge from sewers into creeks and drainage facilities possibly due to pump trouble or the clogging of sewers may be responsible for such a difference. The majority of the escaping sewage will be recovered by the sewerage system after this rehabilitation project. On the other hand, the trunk sewer covering approximately 5 km to Pagla Sewage Treatment Plant has a carrying capacity of only 120,000 m^3/day. Accordingly, the expansion work shall be executed as part of a long-term plan because of its large scale. Therefore, the expected capacity of the treatment plant is designed to meet the current 120,000 m^3/day sewer capacity, which is reasonable in this urgent project aiming at rapid improvement.

The master plan for the plant shall be made on the basis of the capacity of 183,000 m^3/day proposed in the request for aid.

While the medium grade treatment (BOD_5 to be 60 mg/l or below) was selected in consideration of the possible influence of the outfall water on the river, it can be concluded from the current pervasion of sewerage in Dhaka City that the plant plan is well balanced as a whole.

The treatment system was selected by placing priority on the running and maintenance costs, technical convenience for operation and maintenance, construction of a new treatment facility having the capacity of 120,000 m^3/day in the currently available WASA plant space, and availability of options for the treatment system at the time of capacity expansion to 180,000 m^3/day in the future. Judging from the current WASA financial condition, the project plan is well balanced as a whole.

9. Conclusion and Recommendation

9. Conclusion and Recommendation

It is understood that the Government of Bangladesh is preparing a new master plan for future drastic improvement to solve the current problems in the sewerage services of Dhaka City. Regarding the current operating conditions of the sewerage facilities, some facilities are out of order and others have been left damaged. If such situation continues, their superannuation will accelerate rapidly. On the other hand, the expansion of sewers has resulted in greatly exceeding the capacity of the treatment plant where the quality of treated water is not satisfactory. This is the reason why urgent improvement is also required for the plant.

Under such circumstances, improvement and repair of the sewerage facilities of Dhaka City are urged on the basis of priority in order to recovery their proper functions. From this viewpoint, it is significant to implement this project aiming at urgent improvement as soon as possible with the assistance of grant aid from the Government of Japan.

The following are the recommendations presented to both governments for the effective and smooth implementation of this project.

1) Improvement of sewerage facilities in this project is limited to the sections with priority and drastic overall improvement is not planned. It is desirable to execute such drastic improvement on the basis of a new master plan at an early stage.

2) Even though a separate sewage system is generally applied to the sewerage of Dhaka City, many sewers have been connected to drainage. DPHE is currently preparing the final report of the feasibility study on drainage in another JICA project. As the sewerage improvement project and the drainage improvement project are closely related to each other, it is desirable to prepare the middle-term and long-term plans with proper coordination between them.

3) The pumps of each lifting pump station are operated by manual mode with visual checking of the sewage level. However, as the operation is not conducted under proper control and instruction, some stations are shut down for a long time at night. It is necessary to study how to execute proper operation and maintenance of the sewerage system.

4) It was observed at many places that insufficient cleaning of sewers allow overflow of sewage. Hence, supply of cleaning facilities is included in this project. However, in order to achieve effective results, it is desirable to dispatch experts for on-the-job training during the period of this project.

Appendix

(Appendix-1)

Persons Concerned,
Itinerary of the Study Team

1.1 Field Study on Basic Design

1.1.1 Composition of the Study Team

Shinji OHMORI	Team Leader Japan Sewage Works Agency, Research and Technology Department Division
Osamu KOSEGAWA	Project Coordinator Japan International Cooperation Agency (JICA) Grant Aid Department, Basic Design Division
Kenji HORI	Sewage Planner Nippon Joge Suido Sekkei Co., Ltd.
Keizo UEHARA	Sewage Treatment Facilities Nippon Joge Suido Sekkei Co., Ltd.
Satoshi KACHI	Sewer System Nippon Joge Suido Sekkei Co., Ltd.
Hiroki FUJIWARA	Mechanical Facilities Nippon Joge Suido Sekkei Co., Ltd.
Yoshihiro AKIYAMA	Electrical Facilities Nippon Joge Suido Sekkei Co., Ltd.

1.1.2 Itinerary of the Study Team

	Date	Activities
1	3 September (Thurs.)	Departure from Tokyo
2	4 September (Fri.)	Arrival at Dhaka via Bangkok Courtesy visit to JICA office
3	5 September (Sat.)	Research on the environmental conditions
4	6 September (Sun.)	Courtesy visit to ERD, PC, MOLGDC, WASA and Embassy of Japan
5	7 September (Mon.)	Field study and discussion with WASA
9	11 September (Fri.)	
10	12 September (Sat.)	Signing the minutes of meeting Ohmori and Kosegawa left Dhaka for Japan
11	13 September (Sun.)	Field study including surveying and boring, and discussion with WASA
28	30 September (Wed.)	
29	1 October (Thurs.)	Hori and Uehara left Dhaka for Japan. (Akiyama : From 10 September to 24 September Fujiwara: From 3 September to 28 September Kachi : From 3 September to 30 September)
30	2 October (Fri.)	Arrival at Tokyo via Bangkok

1.1.3 Bangladesh People Concerned

(1) Dhaka Water Supply and Sewerage Authority

Brig. Chowdhury Khalequzzaman	:	Chairman
S.A.N.M. Washed	:	Chief Engineer
Nurul Huda Miah	:	Commercial Manager
S.A.M. Nasir Uddin	:	Secretary
Abdul Muqeet	:	Superintending Engineer
M.R. Hyder	:	Superintending Engineer
Mahbubur Rahman	:	Superintending Engineer
Sana Ullah	:	Superintending Engineer
Md. Sanaullah	:	Superintending Engineer
Q.G. Mowla	:	Executive Engineer
A.K.M. Jafarullah	:	
Q. Zahidul Arif	:	Mech. Engineer
M.A. Jalil	:	Asstt. Chief

(2) External Resources Division, Ministry of Finance

Md. Nasim	:	Deputy Secretary

(3) Planning Commission

Nurul Hoque	:	Division Chief

(4) Ministry of Local Government,
Rural Development and Cooperatives

M.A. Hakim	:	Joint Secretary

(Appendix-2)

Minutes of Discussion (1)
Minutes of Discussion (2)
Minutes of Discussion (3)
Minutes of Discussion (4)

Minutes of Discussion (1)

MINUTES OF DISCUSSION
ON
the Sewerage Construction and Rehabilitation Project
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a preliminary study on the Sewerage Construction and Rehabilitation Project (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the People's Republic of Bangladesh the study team headed by Mr. Yasuo NISHIGUCHI, Deputy Director, Sewerage Planning Division, Sewerage and Purification Department, Ministry of Construction (hereinafter referred to as "the Team") from June 1 to 13, 1987.

The team had a series of discussion on the Project with the officials concerned of the Government of the People's Republic of Bangladesh headed by Mr. S.A.N.M. Wahed, Chief Engineer, DWASA and conducted a field survey in the relevant areas to the project.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the project.

Dhaka, June 11, 1987

Yasuo Nishiguchi

Mr. Yasuo NISHIGUCHI
Team Leader
Preliminary Study Team
Japan International
Cooperation Agency.

LT.BRIG. CHOWDHURY KHALEQUZZAMAN (Retd.)
CHAIRMAN
DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY.

ATTACHMENT:

1. The objective of the Project is to rehabilitate sewage lift stations and Narinda Sewerage Pumping stations, and to improve the existing treatment facilities at Pagla to upgrade the discharged water quality:

2. The site of the Project is located in the city of Dhaka, capital of the People's Republic of Bangladesh. (Site map is atached as Annex I)

3. The Project Components requested by the Bangladesh side are as follows:

   a) Rehabilitation of the existing lift stations and related facilities including rehabilitation of sewer.

   b) Rehabilitation of Narinda central Pumping stations (old and new)

   c) Rehabilitation of Pagla outfall system.

   d) Improvement of the existing sewage treatment plant at Pagla.

4. Water Supply and Sewerage Authority (DWASA) is responsible for the administration of the project.

5. The Bangladesh side has understood Japanese Grant Aid System explained by the Team.

6. Japanese Government will send a Basic Design Study Team at an earlier date in order to collect further information and data and to make the Basic Design in consultation with Dhaka WASA, when this project is regarded as practicable through the report of the preliminary Study.

7. The Bangladesh side shall provide all necessary assistance, information and data relating to the project when the Basic Design Study Team visits the People's Republic of Bangladesh.

Minutes of Discussion (2)

MINUTES OF DISCUSSION
ON
THE SEWERAGE CONSTRUCTION AND REHABILITATION PROJECT FOR DHAKA WASA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request made by the Government of the People's Republic of Bangladesh for the Sewerage Construction and Rehabilitation Project (hereinafter referred to as 'the Project') the Government of Japan has sent, through the Japan International Cooperation Agency (hereinafter referred to as 'JICA') which is an official agency implementing the technical cooperation of the Government of Japan, the team headed by Mr. Shinji Omori, to conduct the survey for 28 days from September 3 to 30, 1987.

The team carried out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the People's Republic of Bangladesh.

Both parties have agreed to recommend to their respective Governments and the Authorities concerned to examine the attachment herewith towards the realization of the project.

Dhaka, September 10, 1987.

Shinji Omori
Team Leader
Basic Design Study Team
Japan International
Cooperation Agency.

Brig. Chowdhury Khalequzzaman
(Retd.)
Chairman
Dhaka Water Supply and
Sewerage Authority.

ATTACHMENT

1. The Japanese side explained the inception report of the Basic Design Study and the Bangladesh side understood it with certain observations as conveyed to the Japanese Team. The Scope of the work to be covered is shown in Annex-I.

2. Both parties confirmed the objective of the project with regard to the Sewerage Construction and Rehabilitation, the Project site, the executing body and the project components as mentioned in the articles a,b,c and d of the Minutes of Discussions of the Preliminary Study Team signed on the 11th June, 1987.

3. The team will convey to the Government of Japan the request of the Government of the People's Republic of Bangladesh that the former takes necessary measures to cooperate by implementing the project within the scope of Japanese economic cooperation programme in grant form.

4. With regard to the improvement of the existing Pagla Sewerage treatment plant, the Team is to compare and contrast the following alternatives:
   (1) Primary S.T. and expansion of the Ponds.
   (2) Trickling Filter (Including P.S.T)
   (3) Aerated Lagoon.
   (4) Others.

5. The Government of Bangladesh will take necessary measures as listed in Annex-II on condition that grant assistance by the Government of Japan is extended to the Project.

S.C.

ANNEX-I

The scope of the work to be covered is as follows:

1) The study will be implemented as an urgent improvement plan of the existing sewerage system of Dhaka city, in which existing reference data on the long term plan will be put in order to more accurately define the purposes of this project.

2) The study and evaluation of the capacity of the existing sewer pipelines and sewage treatment facilities will be performed. However, the rehabilitation and expansion of the trunk sewer and branch sewer are excluded from the subject of this plan except trunk sewers related to Hazaribagh L.S. and Narinda P.S. and few other places where urgently necessary for recovering the function of the existing trunk sewer.

3) The lift stations and pumping stations facilities will be surveyed for the operation and functioning conditions of the existing facilities, and rehabilitation of the pumps, pumping stations and improvement of the accessory equipment will be implemented as required.

4) The sewage treatment facility will be examined both in terms of quality and quantity to be treated. The planned quantity of sewage to be treated will be determined taking into consideration the result of this study and that of evaluation of the existing sewage quantity and the maximum conveyance capacity of sewer piping from Narinda and Shamibag upto Pagla.

S. O.

(more)

5) The discharge piping of treated water from the Pagla treatment facility to Burhi Ganga River will be examined whether or not the piping has a capacity sufficient for discharging the quantity of treated water as well as resistance against pressure of the highest flood water level of the river at the Pagla treatment facilities. If no, improvement of the piping will be performed.

6) The effect of use and the appropriate capacity of the equipment will be investigated on the cleaning equipment of sewer piping including sludge carrying facilities. The professional training will be provided.

7) From among the above mentioned improvement plans, as stated in items 1,2,3,4,5 & 6, the feasible plans to be addressed to the basic design will be selected taking into consideration the results of the study and evaluation of urgencies and total project cost including operation and maintenance cost.

ANNEX-II

Following arrangements will be required to be taken by the Government of Bangladesh.

1. To provide necessary data as per as possible for smooth completion of the study.

2. To provide facilities for distribution of electricity, water supply, drainage, telephone lines and other incidental facilities to the project site.

3. To ensure prompt unloading, tax exemption as applicable, customs clearance at ports of disembarkation in Bangladesh of the products purchased under the grant.

4. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the products and services under the verified contracts. In this regard the existing Govt.'s (The Government of Bangladesh) rule will be followed.

5. To accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the verified contracts, with such facilities which may be necessary for their entry into Bangladesh and stay therein for the performance of their work.

6. To maintain and use properly and effectively the facilities constructed and equipment purchased under the grant.

7. To undertake incidental civil works such as gardening, fencing, gates, guard house and extorior lighting.

S.O.

Minutes of Discussion (3)

MINUTES OF DISCUSSION
ON
THE BASIC DESIGN SURVEY WORKS FOR DETAILED DESIGN DRAWING OF THE SEWERAGE CONSTRUCTION & REHABILITATION PROJECT FOR DHAKA WASA
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request made by the Government of the People's Republic of Bangladesh for the Sewerage Construction and Rehabilitation Project therinafter referred to as the Project's the Government of Japan has sent, through the Japan International Cooperation Agency thereinafter referred to as 'JICA' which is an official agency implementing the technical cooperation of the Government of Japan, the team headed by Mr. Shinji Omori, to conduct the survey for 28 days from September 3 to 30, 1987.

The team carreid out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the People's Republic of Bangladesh.

Both parties have agreed to recommend to their respective Governments and the Authorities concerned to examine the attachment herewith towards the realization of the project.

Dhaka, September 30, 1987

Kenji Hori
Project Manager and
Sewerage facilities Planning
Basic Design Survey Team
Japan International Co-operation Agency.

Brig. Chowdhury Khalequzzaman (Retd.)
Chairman
Dhaka Water Supply and Sewerage Authority.

ATTACHMENT

1. Collected Data

   (1) The existing latest long-term development plan on water supply and Sewerage systems in Dhaka is detailed in the Feasibility Report dated April 24, 1981 prepared by RMP and J.M. Montogomery.

   (2) The unit of quantity of water which is being used in the several datas, including the capacity of pumps marked on the same is to be understood as IMGD or igpm, i.e. imperial gallon.

   Therefore, the "US gpm" indicated in Figure 5-4, page 5-23, out of the said Feasibility Report should be read into "igpm".

2. The preferential facilities to be addressed to the basic design study are as follows:

   (1) Pumps and other accessories of the lift stations and Central pumping station.

   The detail of the facilities to be covered is shown in Annex 1.

   (2) Reconstruction of the sump-wells including bar screens and inlet sewer at the new Narinda P.S.

   (3) Replacement of the sewer pipe line (Discharging side) leading to the lift pump at the Hazaribag L.S.

   The sewer should be provided with a pressure pipe line inorder to enable the sewage to flow by natural force to the next lift station.

   The existing sewer for the same distance replaced into pressure pipe line should be used for sewage collection pipe line covering Hazaribag L.S. Industrial West Water, however is not required.

(4) Improvements on the existing Pagla STP

(a) Case-1 that is the treatment process of PST and expansion of the existing ponds out of the comparing alternative plans which are shown in Annex 2, is to be selected as the feasibility treatment method for Pagla STP because of the most low operation and maintenance cost. The stabilization ponds should be limited inside WASA land for the basic design study.

(b) Total sewge treatment capacity of Pagla (Pagla STP) is to be provided with approximately 40 IMGD (183.000 M3/day) based on the grant request from the Bangladesh side.

(c) The capacity of Pagla STP to be constructed by this basic design study, however, should be planned based on the study of the conveyance capacity of the existing trunk sewer pipe line between junctions of sewers coming from Narinda and Swaminbag, and Pagla without any another additional pressure to be given to the existing 54" brick sewer line, i.e. approximately 25 IMGD (120.000^3 /day).

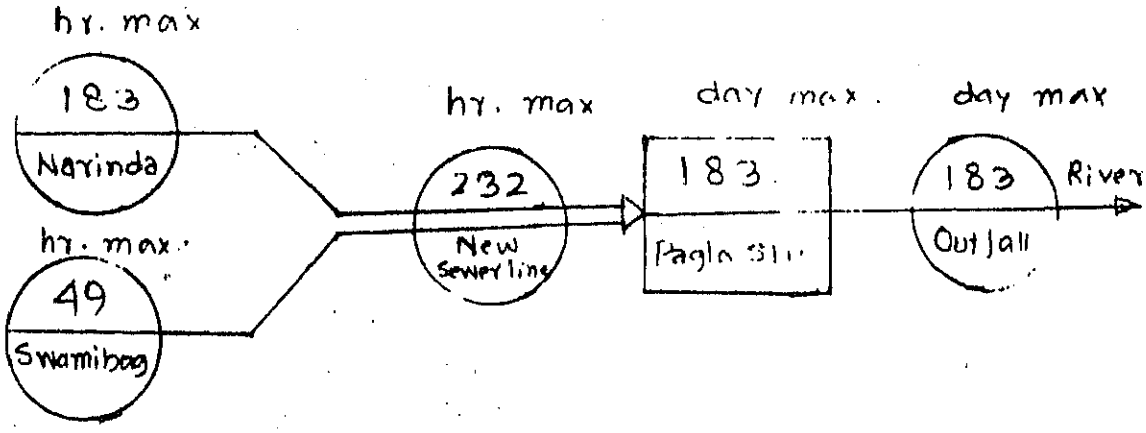
(d) The capacity of major facilities in terms of the total planning and this basic design study should be provided as follows:-

DESIGN CONDITION

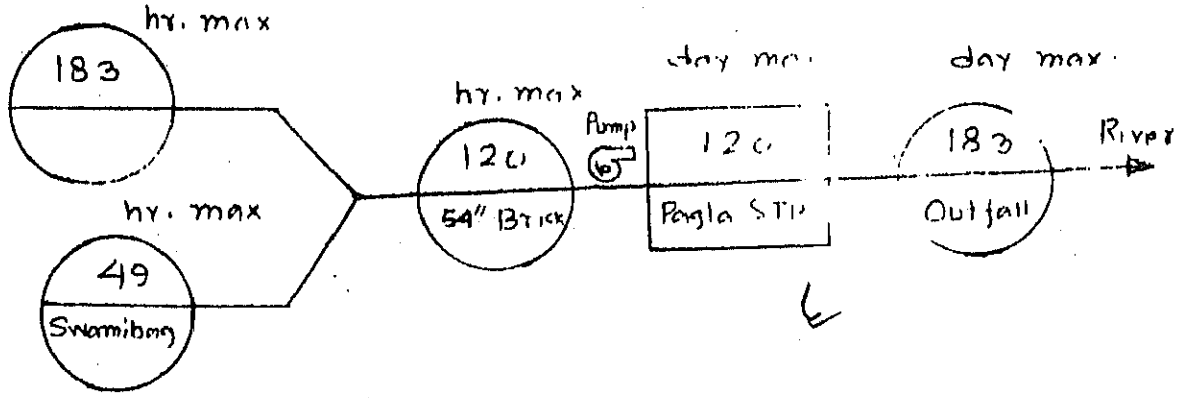
	TOTAL PLANNING	BASIC DESIGN	ESISTING
NEW NARINDA P.S. (Total pump cap.)	hr max. 183.000 m3/D	hr max. 183.000 m3/D	hr max 183.000 m3/I
SWAMINBAG L.S. (Total pump cap.)	hr max. 49.000 m3/D	hr max. 49.000 m3/D	hr max 49.000 m3/D
SEWER LINE (54"Brick Sewer)	hr max 232.000 m3/D	hr. max 120.000 m3/D	hr max 120.000 m3/D
PAGLA S.T.P.	day max. 183.000 m3/D	day max. 120.000 m3/D	day max. 37.000 m3/D
PAGLA OUT FALL	day max 183.000 m3/D	day max. 183.000 m3/D	day max. 183.000 m3/D

DESIGN CAPACITY OF MAJOR FACILITIES IN TERMS OF TOTAL PLANNING AND BASIC DESIGN STUDY

TOTAL PLANNING



BASIC DESIGN STUDY



(5) Construction of the discharge piping of treated water from the Pagla STP to Burhi Ganga River.

a) The discharge pipe should be limited till the existing gatemanhole which is located inside the road or bank of the river, which means that the existing pipe crossing the road or bank of the river, and the last manhole distributing treated water continue to function.

b) The site to be used for installation of the pipe should be provided by the Bangladesh side.

(6) The cleaning equipment of sewer piping:

1) High pressure sewer cleaner x 5 Nos. with spare hoses

2) Vacuume Sewage cleaning truck x 5 Nos.

3) 4 ton capacity sludge carrying pick-up x 5 Nos.

4) Bucket machine x 5 Units.

5) Pipe cleaning tool x 5 Units.

6) Sludged de-watering pump petrol/diesel driven alongwith hose pipe x 1 Unit.

3. The following should be inserted in the basic design study based on the minutes of discussion of the basic design team signed on September 10, 1987

1) About 75m of 42" dia m.s. discharge piping infront of old Narinda Sewage pump station needs be urgently replaced.

2) About 150 metre length of 24" dia R.C.C. sewer between Asadgate and Tejgaon Sewage lift stations is in bad condition and replacement of the same is urgently necessary.

3) About 100m length of 24" dia R.C.C. sewer between Gulshan and Tejgaon lift station needs be replaced immediately.

4) About 200m of 36" & 48" dia equivalent brick sewer from Tejgaon to Swaminbag lift stations needs be rehabilitated immediately.

The item No. 2, 3 & 4 could not be shown to the Consultants as the sewers in question are under water.

4. From among the above mentioned improvement plans, the feasible plans to be addressed to the basic design will be selected taking into consideration to results of the study and evaluation of urgencies and total project cost including operation and maintenance cost.

ANNEX 1

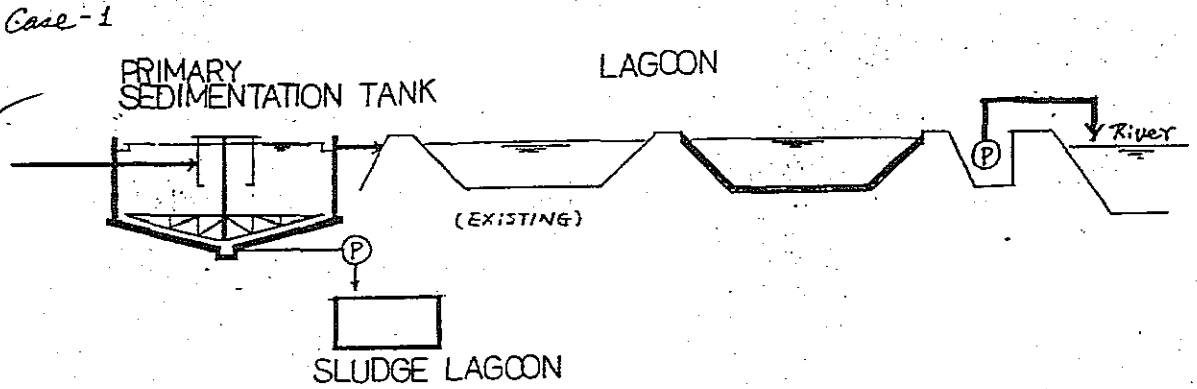
A>B>C : Priority for to be replaced or reconstructed.

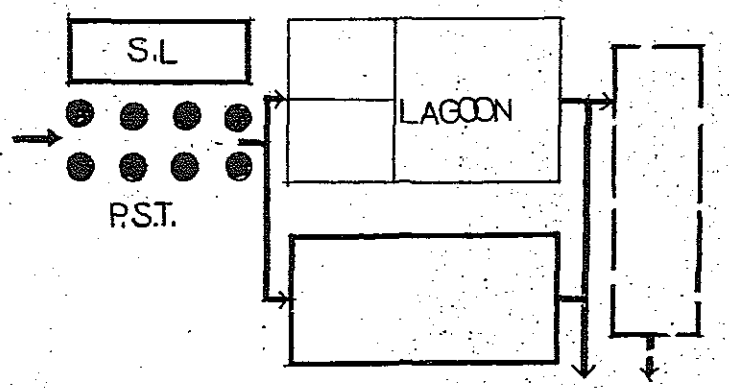
Item Name of L/S	(a) Pump	(b) Vacume pump	(c) Sump pump	(d) Inlet Gate	(e) Screen	(f) Panel	(g) Generator	(h) Transformer	(i) Pipe and valves
Nawabganj (1964)	A (S)	-	-	A	A	A	-	-	A
Azimpur (1956)	B (V)	-	A	A	A	A	-	-	B
Medical Cal. (1968)	C (V)	A	A	A	A	A	-	-	C
Hazaribag (1978)	A (S)	-	-	A	A	A	-	A	A
New Market (1967)	C (V)	A	A	A	A	A	-	-	A
Nagbazar (1956)	B (S)	-	-	A	A	A	-	-	B
P&T (1956)	C (V)	-	A	A	A	A		-	C
Asad Gate (1978)	C (V)	A	A	A	A	A	good	-	A
Tejgaon (1977)	C (V)	A	A	A	A	A		good	A
Bashaboo (1976)	C (V)	A	A	A	A	A	-	good	A
Swaminbag (1978)	C (V)	A	A	A	A	A	-	good	A
Faridabad (1968)	A (S)	-	-	A	A	A	-	-	A
Narinda (old) (1923)	A	A	A	A	A	A	-	A	A
Narinda (New) (1978)	good	A	A	A	A	A	good	A	C

Item Name	(j) Delivery Tank	(k) Delivery Pipe line	(l) Repair of Structure	(m) Movable Sumersible pump	(n) W.Level Indicator
Nawabganj	C	C	A	C	A
Azimpur	C	C	A	A	A
Medical Call	C	A	C	A	A
Hazaribag	A	A	A	A	A
New Market	C	C	C	A	A
Nagbazar	good	good	A	A	A
P&T	C	C	A	A	A
Asad Gate	C	C	C	A	A
Tejgaon	C	C	A	A	A
Bashaboo	C	C	A	A	A
Swaminbag	C	C	C	A	A
Faridabad	C	A	C	C	A
Narinda (old)	-	-	A	A	A
Narinda(new)	-	-	A	A	A

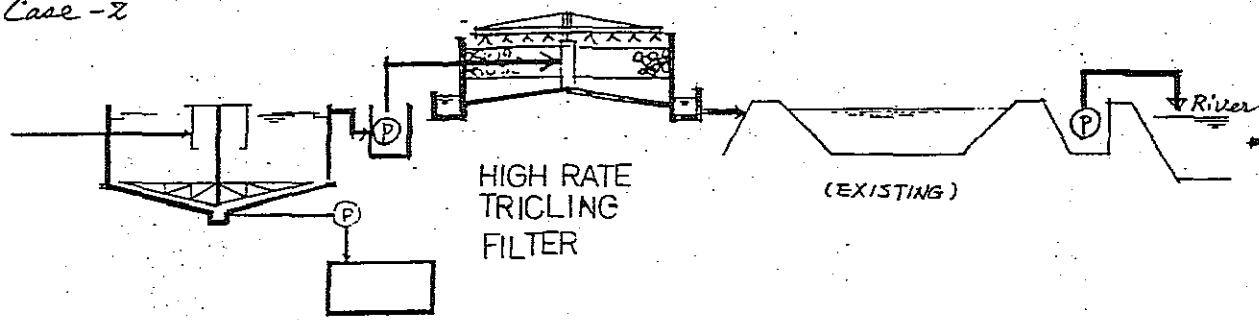
Comparison Alternative Proces for Pagla sewage Treatment Plant

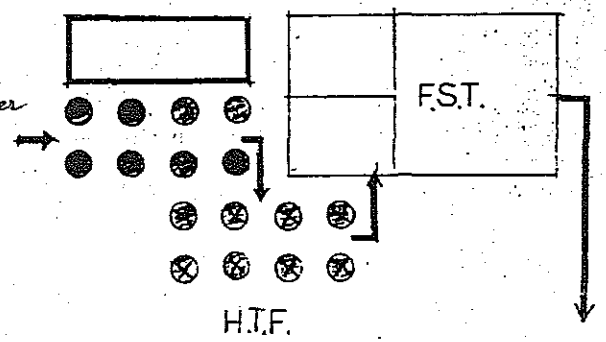
Case-1



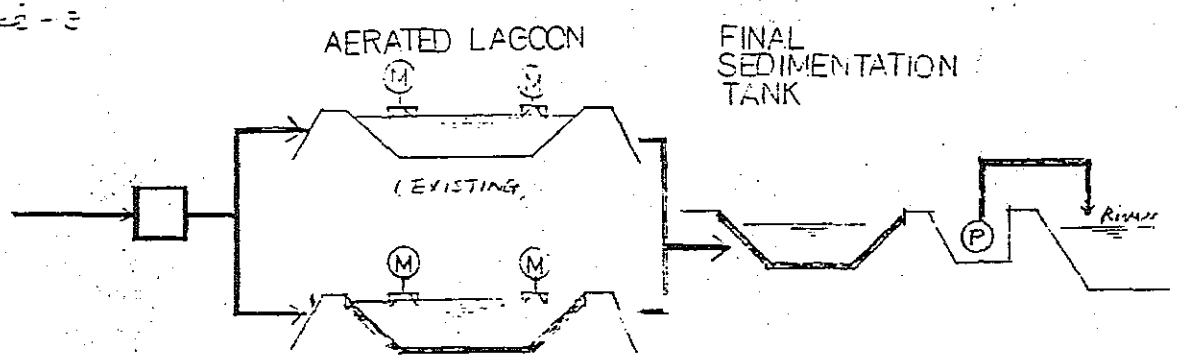


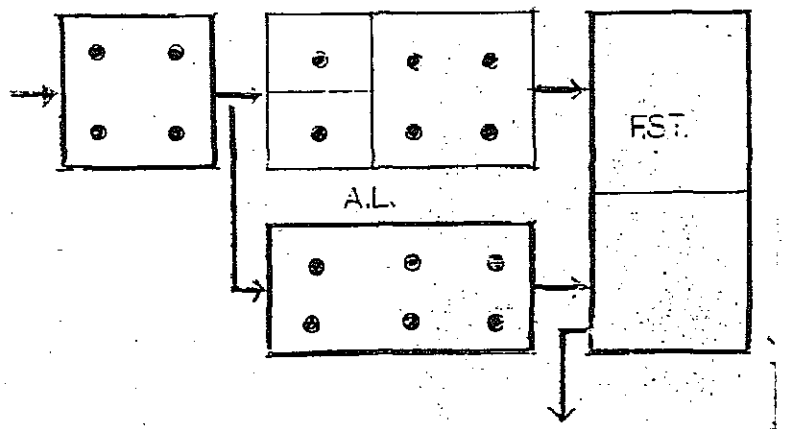
Case-2



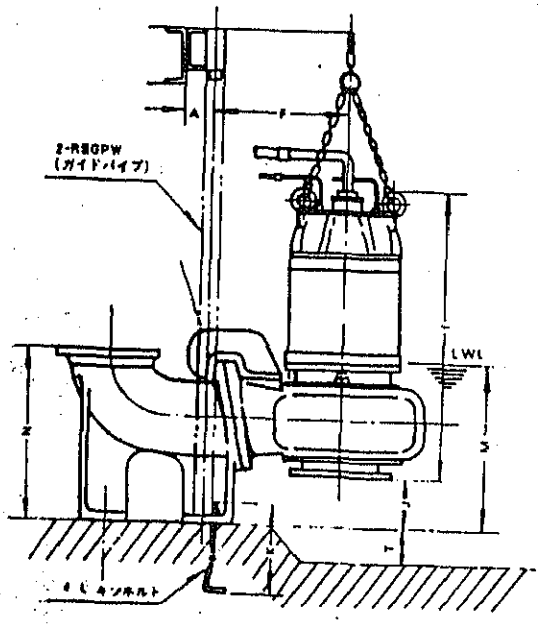


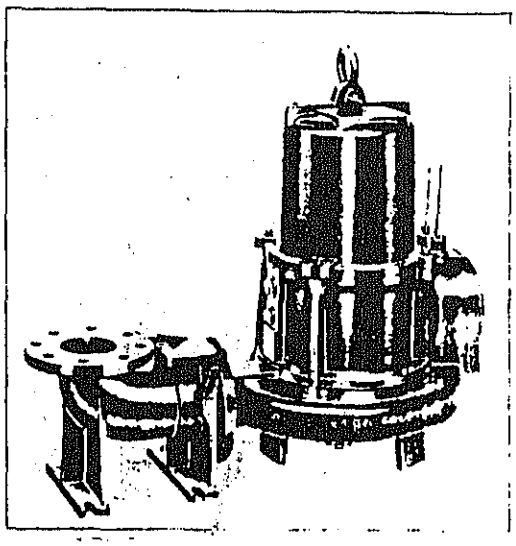
Case-3





Annex - 3 Submergible Pump.





Annex-2 Comparison Table for Alternatives

Item \ Case	Case.1 Primary S.T. and Lagoon	Case.2 Primary S.T. w.1 Trickling Filter	Case.3 Facaltative Aerated Lagoon	Remarks
1. Design Basis				
Daily Flow	130.000 m^3/d (Approx. 40 MGD)			
Water Quality (Approx.)	BOD(mg/l) SS(mg/l)	Same as Case.1	Same as Case.1	
Influent	250 200			
Effluent	50 60			
2. Facilities				
	① Primary Sedimentation Tank ϕ29m × 3m^H × 8 Tanks	① Primary Sedimentation Tank ϕ29m × 3m^H × 8 Tanks	① Facaltative Aerated Lagoon Rt. = 4 days (Exist) 329.100m^2 × 1.5m^H (Expansion) 156.000m^2 × 1.5m^H	
	② Sludge Collector ϕ29m × 1.5 KW × 8 sets	② Sludge Collector ϕ29m × 1.5KW × 8 sets	② Surface Aerator 22 KW × 60 sets	
	③ Raw Sludge Pump ϕ100mm × 1.1 m^3/m × 5m^H × 3.7KW × 8 Sets	③ Raw Sludge Pump ϕ100 × 1.1 m^3/m × 5m^H × 3.7KW × 8 sets	③ Sedimentation Pond Rt = 1 days 90.000 m^2 × 2m^H	
	④ Lagoon Rt = 6 days (Exist) 329.100m^2 × 1.5m^H (Expansion) 390.900m^2 × 1.5m^H	④ Lift Pump (Existing Out fall pump) 1000 gpm × 20HP(15KW) × 2 sets 2.500 gpm × 30HP(22KW) × 2 sets 7.000 gpm × 75HP(55KW) × 3 sets		
	⑤ Sludge Lagoon 80.000 m^2 × 2.0m^H	⑤ Trickling Filter ϕ34m × 2m^H × 8 Tanks		
		⑥ Lagoon, Rt = 2.7 days (Approx.) (Exist) 329.100m^2 × 1.5m^H		
		⑦ Sludge Lagoon 80.000 m^2 × 2.0m^H		
	⑥ Out-Fall Pump ϕ400 × 25 m^3/m × 55 KW × 6 sets (1 set stand-by)	⑧ Out-Fall Pump ϕ400 × 25 m^3/m × 55 KW × 6 Sets (1 set stand-by)	④ Out-Fall Pump ϕ400 × 25 m^3/m × 55KW × 6 Sets (1 set stand-by)	* Out-Fall pump shall be operated in a rainy season and not operated dry season.
3. Total Power Consumption (Approx.)	Dry Season 373.7 KWH/D	Dry Season 5.139.3 KWH/D	Dry Season 26.100 KWH/D	
	Rainy Season 5658.7 KWH/D	Rainy Season 10.419.3 KWH/D	Rainy Season 31.380 KWH/D	
4. Power Charge (Approx.)	Dry Season M1.107.4 TK/6mon.	Dry Season 1.942.665 TK/6mon.	Dry Season 9.855.800 TK/6mon.	
	Rainy Season 2.137.099 TK/6mon.	Rainy Season 3.938.495 TK/6mon.	Rainy Season 11.861.640 TK/6mon.	
	Total 2.278.206 TK/year	Total 5.881.150 TK/year	Total 21.717.440 TK/...	

Minutes of Discussion (4)

MINUTES OF DISCUSSION
ON
THE DRAFT FINAL REPORT OF THE BASIC DESIGN STUDY
ON
THE SEWERAGE CONSTRUCTION AND REHABILITATION PROJECT
FOR DHAKA CITY
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a basic design study on the Sewerage Construction and Rehabilitation Project for Dhaka city and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Bangladesh the study team from September 3 to 30 , 1987.

As a result of the study, JICA prepared a Draft Final Report on the Study and dispatched a mission, headed by Mr. Yasuo Nishiguchi, Deputy Director, Sewerage Planning Division, Sewerage and Purification Department, Ministry of Construction, to explain and discuss it from January 6 to 16, 1988.

Both parties had a series of discussions on the Report and have agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Dhaka, March 21 ,1988

NORIO MATSUZAWA
Resident Representative
Japan International Cooperation Agency

BRIG. CHOWDHURY KHALEQUZZAMAN (Retd)
Chairman
Dhaka Water Supply and Sewerage Authority

ATTACHMENT ONE

Major points of understanding are as follows:

1. The Bangladesh side agreed in principle to the basic design proposed in the draft final report to be incorporated in the basic design study report.

2. Ten (10) copies of final reports in English for basic design on the project will be submitted to the Government of the People's Republic of Bangladesh in March, 1988.

3. The Bangladesh side has understood the system of Japan's Grant Aid Programme and confirmed the arrangements to be taken by the Government of the Poeple's Republic of Bangladesh for the realization of the project as agreed upon in the " Minutes of Discussion " dated September 10,1987.

4. The site to be used temporarily by the construction contractors for construction of the facilities shown below should be provided by Bangladesh side.

   (1) The site for installation of the out fall pipe from Pagla S.T.P. to the end gate manhole located at inside the river bank.

   (2) The site for installation of trunk sewer for new Narinda pumping station and other places also.

ATTACHMENT TWO

1. Eight (8) fixed generators (50 KVA) and two (2) movable generators (50 KVA) will be provided in the project for standby use in case of power failure.

2. For flow measuring, two (2) to three (3) ultrasonic flowmeters will be provided in the project.

3. One (1) standby submersible pump each for Hazaribag, Nawabaganj, Faridabad and Old Narinda pumping stations of which pumps are to be replaced in the project, will be provided.

   As for other pumping stations, it is considered there is a standby pump already installed in each station.

4. Spare parts consumed for two (2) to five (5) years for the supplied equipment, pumps, machineries etc. will be provided in the project.

5. An administrative building in Pagla S.T.P. will be two (2) storied instead of one (1) storied.

6. To keep provision for overcoming the difference 6' of level between sump well and inlet manhole in the New Market L.S. should be included.

7. Discharge pipe of Faridabad Station will be replaced only between the Station and Haricharan Roy Road, and Katherpool syphon.

8. Two (2) 375 KVA diesel generators for Pagla S.T.P. as backup in case of a power failure, have already been included in the project.

(Appendix-3)

Comparison of Operation and Maintenance Cost
(120,000 m^3/Day)

APPENDIX COMPARISON OF OPERATION AND MAINTENANCE COST

BASED ON PROPOSED TREATMENT CAPACITY (120,000 m^3/D)

(1/2)

ITEM \ CASE	CASE 1 PRIMARY SEDIMENTATION TANK + FACULTATIVE LAGOON				CASE 2 PRIMARY SEDIMENTATION TANK + HIGH RATE TRICKLING FILTER + SEDIMENTATION POND				CASE 3 AERATED FACULTATIVE LAGOON + SEDIMENTATION POND				REMARK
1. Electric Cost													
a) Consumption	Name of eq't	Nos	kW	Culculation	Name of eq't	Nos	kW	Culculation	Name of eq't	Nos	kW	Culculation	
	. Lift pump	3(1)	45	2 x 45 x 24 x 0.8 = 1,728	. Lift pump	3(1)	90	2 x 90 x 24 x 0.8 = 3,456	. Aerator	26	22	120,000 x (200 - 50) x 10^{-3} x 1/1.8 x 1.0 = 10,000	*1 After taking into consideration of yearly fluctuation of effluent river water level, the operation ratio will be considered as 0.7.
	. Sludge collector	4	2.2	4 x 2.2 x 24 x 0.8 = 169	. Sludge collector	4	2.2	4 x 2.2 x 24 x 0.8 = 169					
	. Raw sludge pump	5(1)	7.5	4 x 7.5 x 2.5 x 0.8 = 60	. Raw Sludge pump	5(1)	7.5	4 x 7.5 x 2.5 x 0.8 = 60	. Chlorine	2(1)	2.2	1 x 2.2 x 24 x 0.8 = 43	
	. Chlorine dosing pump	2(1)	2.2	1 x 2.2 x 24 x 0.8 = 43	. Chlorine dosing pump	2(1)	2.2	1 x 2.2 x 24 x 0.8 = 43					
	. Others			≒ 100	. Others			≒ 200	. Others			≒ 50	
	Sub Total			2,100 kW/day	Sub Total			3,928 kW/day	Sub Total			10,093 kW/day	
	. Outfall pump	7	273	273 x 24 x 0.7 *1 x $\frac{120}{183}$ = 2,406	. Outfall pump	7	273	273 x 24 x 0.7 *1 x $\frac{120}{183}$ = 2,406	. Outfall pump	7	273	273 x 24 x 0.7 *1 x $\frac{120}{183}$ = 2,406	
	Total			4,506 kW/day	Total			6,334 kW/day	Total			12,499 kW/day	
	Electric consumption per year												
	Dry season (abt. 5 mnths, not necessary of outfall pump operation) 2,100 kW/day x 30 x 5 = 315,000 kW				Dry season 3,928 kW/day x 30 x 5 = 589,200 kW				Dry season 10,093 kW/day x 30 x 5 = 1,513,950 kW				
	Rainy season (abot. 7 mnths, necessary of outfall pump operation) 4,506 kW x 30 x 7 = 946,260 kW				Rainy season 6,334 kW/day x 30 x 7 = 1,330,140 kW				Rainy season 12,499 kW/day x 30 x 7 = 2,624,790				
	Total			1,261,260 kWH/year	Total			1,919,340 kWH/year	Total			4,138,740 kWH/year	
b) Electric Cost	1,261,260 KWH/year x 2.1 TK/KWH = 2,648,646 TK/year (100%)				2,919,340 KWH/year x 2.1 TK/KWH = 4,030,614 TK/year (152%)				4,138,740 KWH/year x 2.1 TK/KWH 8,691,354 TK/year (328%)				Electric fee is based on the Tarif of PDB (1987 Aug) 2.1 TK/KWH

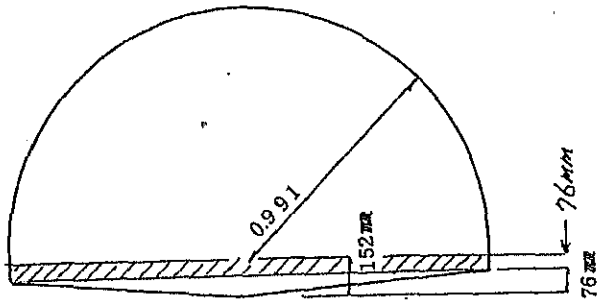
ITEM \ CASE	CASE 1 PRIMARY SEDIMENTATION TANK + FACULTATIVE LAGOON	CASE 2 PRIMARY SEDIMENTATION TANK + HIGH RATE TRICKLING FILTER + SEDIMENTATION POND	CASE 3 AERATED FACULTATIVE LAGOON + SEDIMENTATION POND	REMARK
2. Chemical Cost				
Chlorine for disinfection	Average dosing ratio 3 mg/lit Consumption per day 120,000 m^3/day x 3 mg/lit x 10^{-3} = 360 kg/day Consumption per year 360 kg/day x 365 days = 131,400 kg/day Cost per year 131,400 kg/year x 8.5 TK/kg = 1,116,900 TK/year	Same as Case 1	Same as Case 1	Unit cost of chemical is based on WASA's purchasing cost
3. Personnel	Plant Manager 1 x 48,000 TK/year = 48,000 Technical staff 2 x 36,000 TK/year = 72,000 Operation staff 6 x 12,000 TK/year = 72,000 Total 192,000 TK/year	Plant Manager 1 x 48,000 TK/year = 48,000 Technical staff 2 x 36,000 TK/year = 72,000 Operation staff 8 x 12,000 TK/year = 96,000 Total 216,000 TK/year	Plant Manager 1 x 48,000 TK/year = 48,000 Technical staff 2 x 36,000 TK/year = 72,000 Operation staff 8 x 12,000 TK/year = 96,000 Total 216,000 TK/year	Workers are not included.
4. Maintenance Cost & Others	200,000 TK/year	200,000 TK/year	200,000 TK/year	Totally listed up for slight replacement of parts and repair of the eq't.
5. Operation & Maintenance Cost Total				
Electric Cost	2,648,646	4,030,614	8,691,354	
Chemical Cost	1,116,900	1,116,900	1,116,900	
Personnel Expenses	192,000	216,000	216,000	
Repair & Others	200,000	200,000	200,000	
Total	4,157,546 TK/year	5,563,514 TK/year	10,224,254 TK/year	

(Appendix-4)

Evaluation of Trunk Sewer Capacity

(i) Between the junction manhole and Pagla Sewage Treatment Plant

a) Uniform flow calculation (in the case of pipe grade being equal to energy grade)



Pipe bore = equivalent to 54" (1.37 m) - brick arch pipe

Slope I = 0.00045
(according to Montgomery Report)

Area A = $0.991^2 \times \pi \times 1/2$
+ $0.991 \times 2 \times 0.076$
+ $0.991 \times 2 \times 0.076 \times 1/2$
= $1.77\ m^2$

Wetted perimeter P = $0.991 \times 2 \times \pi \times 1/2 + 0.076 \times 2 + 2 \times \sqrt{0.991^2 + 0.076^2}$
= 5.25 m

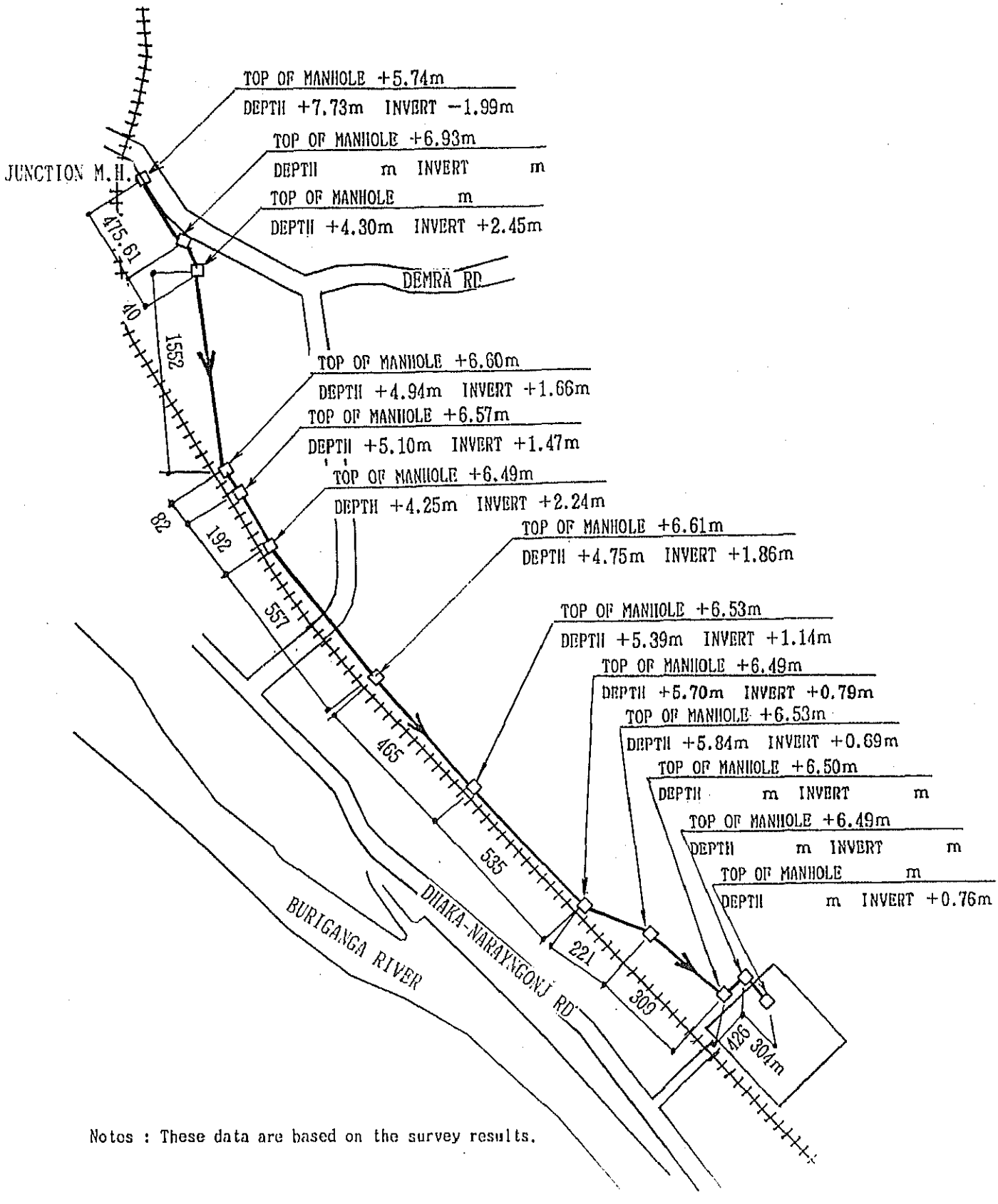
Coefficient of roughness n = 0.015 (brick arch pipe)

Hydraulic mean depth = A/P = 1.77/5.25 = 0.337 $R^{2/3}$ = 0.484 m

I = 0.00045 $\therefore I^{1/2} = 0.0212$

$\therefore V = \frac{1}{0.015} \times 0.484 \times 0.0212 = 0.684$ m/sec

$Q = 1.77 \times 0.684 = 1.21\ m^3/sec = 104{,}602\ m^3/sec$



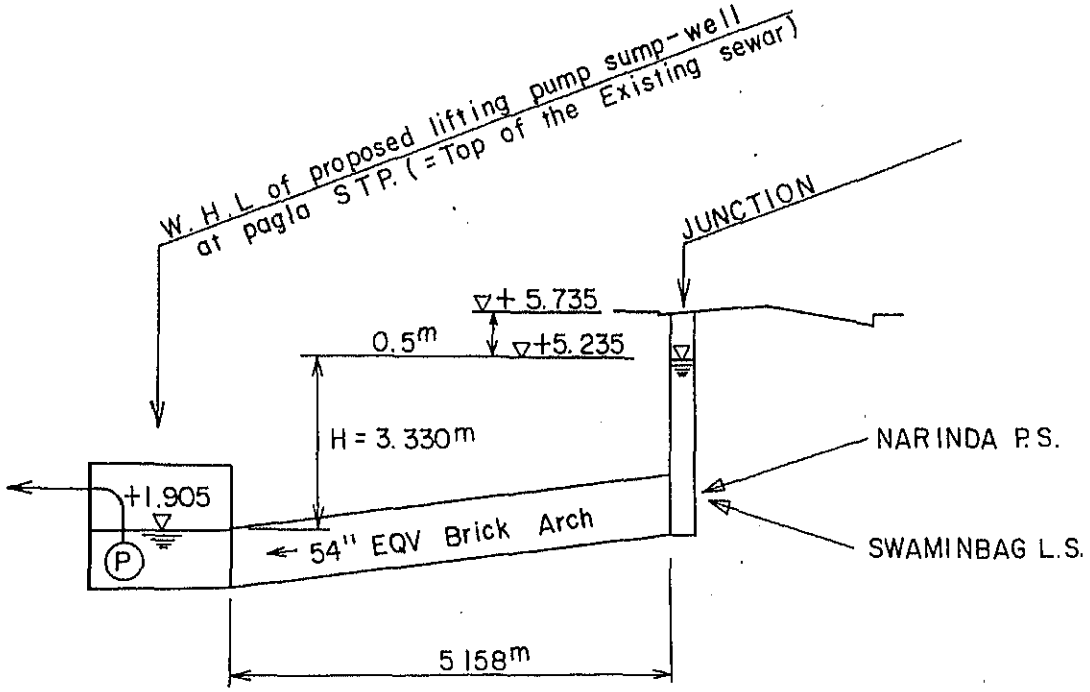
Notes : These data are based on the survey results.

Fig. A4-1 Trunk Sewer Survey To PAGLA S.T.P.

b) Investigation with pressure pipes

Sewer arrangement between the junction manhole and Pagla is as shown in Figure A4-1. Calculation is based on the following assumptions:

Water-level at junction manhole:	0.5 m lower than ground level (+5.235 m)
Operating water-level of sewage treatment plant:	Top of the existing 54" brick arch pipe (+1.905 m)



As mentioned before, A = 1.77 m^2, P = 5.25 m, n = 0.015 & R = 0.337.

($R^{2/3}$ = 0.484)

$$I = \frac{3.330}{5.158} = 0.000646 \quad (I^{1/2} = 0.0254)$$

$$V = \frac{1}{0.015} \times 0.484 \times 0.0254 = 0.820 \text{ m/sec}$$

$$Q = 1.77 \times 0.820 = 1.45 \text{ m}^3/\text{sec} = 125{,}280 \text{ m}^3/\text{day} = 120{,}000 \text{ m}^3/\text{day}$$

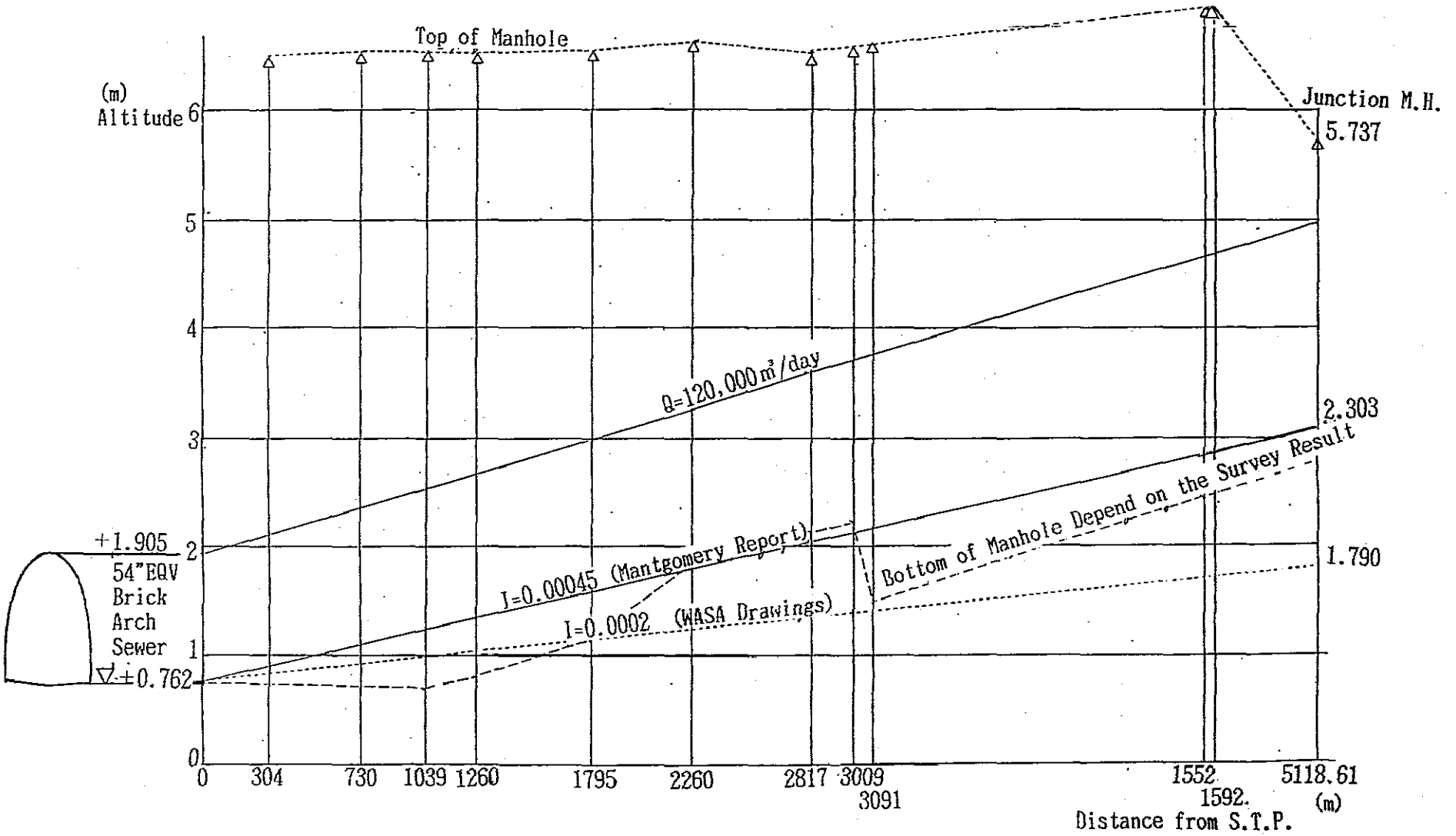


Fig. A4-2 S.T.P. Trunk Sewer Section

The carrying capacity to Pagla Sewage Treatment Plant, therefore, is reasonably considered to be 120,000 m^3/day, and from the viewpoint of reducing initial investment, it is appropriate to design the current improvement plan on the basis of this capacity.

c) Water level at the junction manhole when the trunk sewer capacity between the junction manhole and Pagla plant is assumed to be 120,000 m^3/day:

$$hf = \frac{V^2.n^2}{R^{4/3}} \times \pi = \frac{(\frac{1.39}{1.77})^2 \times 0.015^2}{(0.484)^2} \times 5.158 = 3.055 \text{ m}$$

Water level at junction manhole = 1.905 + 3.055 = 4.960 m

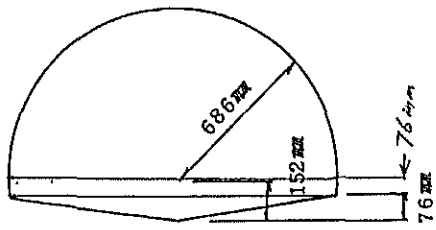
The sectional view of the above result (in the case of Q = 120,000 m^3/day) is shown in Figure 4.__. Pressure on the 54" eqv. brick-arch pipe is about 2.0 t/m^2 at pipe top and about 3.0 t/m^2 at pipe bottom.

(ii) Between Narinda Pump Station and junction manhole

This piping is designed for pressure pipes. Detail is unknown because as-built drawings is unavailable.

Pipe bore = equivalent to 36" (0.914 m) - brick arch pipe

$A = 0.686^2 \times \pi \times 1/2$
$+ 0.686 \times 2 \times (0.152 \times 1/2)$
$+ 0.686^2 \times 2 + 0.076^2$
$= 0.896 \text{ m}^2$



$P = 0.686 \times 2 \times \quad \times 1/2 + 0.152 \times 2 \times 1/2 + 2 \times \sqrt{0.686^2 + 0.076^2}$
$= 3.69 \text{ m}$

$n = 0.015$

Assuming that the ground level at Narinda station is +6.15 m, the distance to junction manhole 500 m and the water level at junction manhole +4.960 m, then:

$$I = \frac{(6.15 - 4.96)}{500} = 0.00238 \quad (I^{1/2} = 0.0488)$$

$$R = \frac{A}{P} = \frac{0.896}{3.69} = 0.243 \text{ m} \quad (R^{2/3} = 0.389)$$

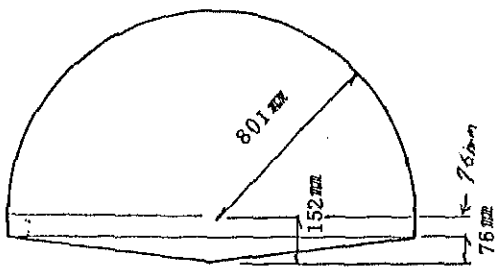
$$V = \frac{1}{0.015} \times 0.389 \times 0.0488 = 1.27 \text{ m/sec}$$

$$Q = A.V = 0.896 \times 1.27 = 1.14 \text{ m/sec} = 98{,}000 \text{ m}^3\text{/day}$$

(iii) Trunk sewer capacity at Swaminbag Lifting Pump Station discharge side

Pipe bore = equivalent to 48" (1.22 m) - brick arch pipe

$$A = 0.801^2 \times \pi \times 1/2 + 0.801 \times 2 \times (0.152 \times 1/2) + 0.801 \times 2 \times 0.076 \times 1/2 = 1.19 \text{ m}^2$$



$$P = 0.801 \times 2 \times \pi \times 1/2 + 0.152 + 2 \times 1/2 + 2 \times \sqrt{0.801^2 + 0.076^2} = 4.28 \text{ m}$$

$n = 0.015$

$$I = \frac{(7.625 - 4.983)}{450} = 0.00587 \quad (I^{1/2} = 0.0766)$$

$$R = \frac{1.19}{4.24} = 0.202 \quad (R^{2/3} = 0.345)$$

$$V = \frac{1}{0.015} \times 0.345 \times 0.0766 = 1.76 \text{ m/sec}$$

$$Q = A.V = 1.19 \times 1.76 = 2.09 \text{ m}^3\text{/sec} = 180{,}956 \text{ m}^3\text{/day}$$

(iv) Trunk sewer capacity at Bashaboo Lifting Pump Station discharge side

Pipe bore = equivalent to 48" (1.22 m) - brick arch pipe, A = 1.19 m^2

The piping is designed as pressure pipes with no grade.

Conditions to obtain energy grade:

Upstream side, ground level at
Bashaboo Station: -0.50 m = +5.237 m

Top of inflow pipe at Swaminbag Station = +2.200 m

$I = \frac{5.237 - 2.200}{2,740} = 0.00111$ $I^{1/2} = 0.0333$

R = 0.278 ($R^{2/3} = 0.426$)

$V = \frac{1}{0.015} \times 0.426 \times 0.0333 = 0.946$ m/sec

$Q = A.V = 1.19 \times 0.826 = 0.983\ m^3/sec = 84,900\ m^3/day$

(v) Trunk sewer capacity at Tejgaon Lifting Pump Station discharge side

Pipe bore = equivalent to 36" (0.914 m) - brick arch pipe

I = 0.00048 ($I^{1/2} = 0.0219$)

A = 0.896 m^2, P = 3.69 m, n = 0.015

R = 0.243 m ($R^{2/3} = 0.389$)

$V = \frac{1}{0.015} \times 0.389 \times 0.0219 = 0.568$ m/sec

$Q = 0.896 \times 0.568 = 0.509\ m^3/sec = 43.978\ m^3/day$

(vi) Trunk sewer capacity at Asad Gate Lifting Pump Station discharge side

Pipe bore = 18" = 0.457 m

$I = 0.016 \quad (I^{1/2} = 0.04)$

$A = 0.457^2 \times \pi \times 1/4 = 0.164\ m^2$

$P = 0.457 \times \pi = 1.44\ m$

$n = 0.013$

$R = \frac{A}{P} = \frac{0.164}{1.44} = 0.114\ m \quad (R^{2/3} = 0.235)$

$V = \frac{1}{0.013} \times 0.235 \times 0.04 = 0.723\ m/sec$

$Q = 0.164 \times 0.723 = 0.119\ m^3/sec = 10,282\ m^3/day$

(vii) Trunk sewer capacity at P&T Lifting Pump Station discharge side

Pipe bore = equivalent to 36" (0.914 m) - brick arch pipe

$I = 0.0026 \quad (I^{1/2} = 0.0510)$

$A = 0.896\ m^2$, $P = 3.69\ m$, $n = 0.015$

$R = 0.243\ m \quad (R^{2/3} = 0.389)$

$V = \frac{1}{0.015} \times 0.389 \times 0.051 = 1.32\ m/sec$

$Q = 0.896 \times 1.32 = 1.18\ m^3/sec = 101,952\ m^3/day$

(viii) Trunk sewer capacity at Mogh Bazar
Lifting Pump Station discharge side

Pipe bore = 24" = 0.610 m

Grade will be determined based on the result of survey.

$I = 0.00856 \qquad (I^{1/2} = 0.0925)$

$A = 0.610^2 \times \pi \times 1/4 = 0.292\ m^2$

$P = 0.610 \times \pi = 1.92\ m$

$n = 0.013$

$R = \frac{A}{P} = \frac{0.292}{1.92} = 0.152 \qquad (R^{2/3} = 0.285)$

$V = \frac{1}{0.013} \times 0.285 \times 0.0925 = 2.03\ m/sec$

$Q = 0.292 \times 2.03 = 0.593\ m^3/sec = 51,235\ m^3/day$

(ix) Trunk sewer capacity at New Market
Lifting Pump Station discharge side

The pipe bore at the discharge side, noted as 18", 24" or 36" depending on the documents, could not be defined because manholes could not be opened at the time of survey.

The inflow capacity here is assumed to be similar to the capacity of discharge pipe; namely, based on the as-built drawing it is assumed to be the same as the capacity of the discharge pipe at Hazaribag Lifting Station.

$Q = 0.213\ m^3/sec$ (Calculation is given later.)

(x) Trunk sewer capacity at Hazaribag Lifting Pump Stations discharge side

Pipe bore = 24" = 0.610 m

$I = 0.0011 \quad (I^{1/2} = 0.0332)$

$A = 0.152$ m, $P = 1.92$ m, $n = 0.013$

$R = 0.152$ m $\quad (R^{2/3} = 0.285)$

$$V = \frac{1}{0.013} \times 0.285 \times 0.0332 = 0.728 \text{ m/sec}$$

$Q = 0.292 \times 0.728 = 0.213 \text{ m}^3\text{/sec} = 18{,}403 \text{ m}^3\text{/day}$

(xi) Trunk sewer capacity at Medical College Lifting Pump Station discharge side

Pipe bore = 12" = 0.305 m

As for grade, the as-built drawing or any other information was unavailable, and on-site survey was impossible since the manhole on discharge side was a non-opening type; it is assumed, therefore, to be similar to that obtained from the result of survey of inflow piping.

$I = 0.0807 \quad (I^{1/2} = 0.284)$

$A = 0.0731 \text{ m}^2$, $P = 0.958$ m, $n = 0.013$

$R = 0.0763 \quad (R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.284 = 3.93 \text{ m/sec}$$

$Q = 0.0731 \times 3.93 = 0.287 \text{ m}^3\text{/sec} = 24{,}797 \text{ m}^3\text{/day}$

(xii) Trunk sewer capacity at Azimpur Lifting Pump Station discharge side

Pipe bore = 12" = 0.305 m

Grade will determined based on the result of survey.

$I = 0.0042 \quad (I^{1/2} = 0.0648)$

$A = 0.0731\ m^2$, $P = 0.958$ m, $n = 0.013$

$R = 0.0763$ m $\quad (R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.0648 = 0.897 \text{ m/sec}$$

$$Q = 0.0731 \times 0.897 = 0.0656\ m^3/\text{sec} = 5{,}668\ m^3/\text{day}$$

(xiii) Trunk sewer capacity at Nawabganj Lifting Pump Station discharge side

Pipe bore = 12" = 0.305 m

Grade will be determined based on the result of surveying.

$I = 0.0127 \quad (I^{1/2} = 0.113)$

$A = 0.0731\ m^2$, $P = 0.958$ m, $n = 0.013$

$R = 0.0763 \quad (R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.113 = 1.56 \text{ m/sec}$$

$$Q = 0.0731 \times 1.56 = 0.0991\ m^3/\text{sec} = 8{,}562\ m^3/\text{day}$$

(xiv) Trunk sewer capacity at Faridabad Lifting Pump Station discharge side

Though various data indicate different values for pipe bore, it is assumed to be 12" = 0.305 m.

Grade will be determined based on the result of survey.

$I = 0.0101 \qquad (I^{1/2} = 0.100)$

$A = 0.0731\ m^2,\ P = 0.958\ m,\ n = 0.013$

$R = 0.0763\ m \qquad (R^{2/3} = 0.180)$

$$V = \frac{1}{0.013} \times 0.180 \times 0.100 = 1.38\ m/sec$$

$$Q = 0.0731 \times 1.38 = 0.101\ m^3/sec = 8{,}726\ m^3/day$$

The above calculation is generally based on full pipe flow (that is, energy grade line approximately coincides with hydraulic grade line). If a lifting pump station at downstream stops operation for a long time, or if the pump well at the said station is at a high operation water-level, the carrying capacity of trunk sewer is expressed so that the sewer capacity will fall below the above calculation.

(Appendix-5)

Result of Measurement of Pump Discharge at Lifting Pump Station

Result of Measurement of Pump Discharge

Pump discharge was measured by ultrasonic sensors attached to the existing piping. The number of pumps measured in the present study was limited due to the following reasons: The trunk sewer to Pagla Sewage Treatment Plant was broken at the time of survey; The pump at the lifting pump station belonging to the plant could not be started due to floods; The piping had no space to attach sensors at a number of pump stations. Measured values were larger than the designed lifting capacity in TableA5-1.This is because the water level of some pumps were high due to the shut down of the pumps for a long time, and these pumps could not achieve the designed lift.

Table A5-1 : Result of Measurement of Pump Discharge

Facility name	Design capacity of pump GPM / (m^3/m^3)	Measured value m^3/m	Remarks
Narinda Pump Station	No.5 2,500 / (11.37)	18.355	Only No.5 running '87.9.13
	No.5 2,500 / (11.37)	18.165	Both No.5, No.6 running '87.9.13
	No.6 1,000 / (4.55)	9.320	Only No.6 running '87.9.13
Swaminbag Lifting Pump Station	No.2 1,500 / (6.82)	8.509	Only No.2 running '87.9.19
Medical College Lifting Pump Station	No.1 500 / (2.27)	3.096	Dia. of delivery pipe-6" '87.9.19
	No.2 500 / (2.27)	2.042	Dia. of delivery pipe-4" '87.9.19
P & T Lifting Pump Station	No. 1 1,500 / (6.82)	7.012	Only No.1 running '87.9.12

(Appendix-6)

Result of Water Examination

Table A6-1 Anaerobic Ponds Effluent Qualities[3)]

Location	pH	Temperature (°C)	Trans-parency (cm)	BOD5 (mg/l)	Colour	SS (mg/l)	Date
No. 1 Lagoon	7.2		2 - 3	104	Slightly dark grey	328	Feb. 27/1985
No. 3 Lagoon	7.2		5 - 6	118	Slightly dark grey	31	Feb. 27/1985
No. 2 Lagoon	7.2	27.5	2.0	56	Light pink	111	Mar. 3/1985
No. 3 Lagoon	7.2	27.5	5.0	76.5	Light green	39	Mar. 3/1985

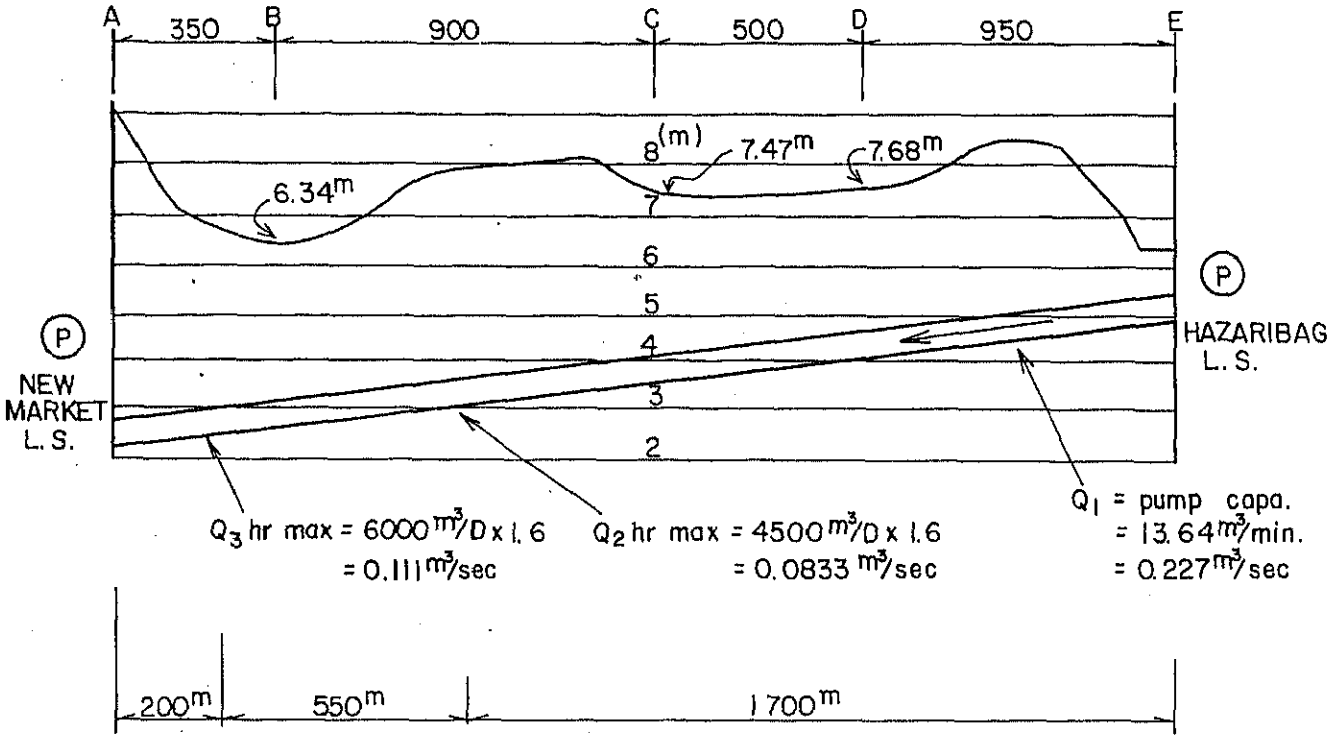
Table A6-2 BOD_5 at 20°C for Pagla Sewerage Treatment Plant and Burhiganga River

Period	Influent	Effluent	Upstream of discharge point at Burhiganga River (Direct downstream)	Downstream of discharge point at Burhiganga River (Direct downstream)
In last wet season (1986.10.7)	250	86	2.8	19.0
In last dry season (1986.12.2)	210	76	2.2	17.0

(Appendix-7)

Calculation of Head Loss between Hazaribag Lifting Pump Station and New Market Lifting Pump Station

Calculation of head loss between Hazaribag Lifting Pump Station and New Market Lifting Pump Station.



Friction loss in 'a' section:

L = 200 m, 24" dia. = 610 mm, $Q = Q_1 + Q_2 + Q_3 = 0.421\ m^3/sec$

$A = 0.292\ m^2$, P = 1.92 m, R = 0.152 m, n = 0.013, V = 0.421/0.292 = 1.44 m/sec

Manning's formula:

$$hf = \frac{U^2.n^2}{R^{4/3}} .1 = \frac{1.44^2 \times 0.013^2}{0.152^{4/3}} \times 200 = \frac{2.07 \times 0.000169}{0.0811} \times 200 = 0.862\ m$$

Friction loss in 'b' section:

L = 550 m, 24" dia. = 610 mm, $Q = Q_1 + Q_2 = 0.310\ m^3/sec$,
$A = 0.292\ m^2$, P = 1.92 m, R = 0.152 m, n = 0.013 V = 0.310/0.292 = 1.06 m/sec

Manning's formula:

$$hf = \frac{1.06^2 \times 0.000169}{0.0811} \times 550 = 1.288\ m$$

Friction loss in 'c' section:

L = 1,700 m, 24" dia. = 610 mm, $Q = Q_1 = 0.227\ m^3/sec$, $A = 0.292\ m^2$
P = 1.92 m, R = 0.152 m, n = 0.013, V = 0.227/0.292 = 0.777 m/sec

Manning's formula:

$$hf = \frac{0.777^2 \times 0.000169}{0.0811} \times 1{,}700 = 2.139\ m$$

When the operating water level at New Market Lifting Pump Station is assumed 1 m lower than the machine room floor level (+5.540):

Operating water level (A point) = +5.540 - 1.000 = +4.540 m

B point $= +4.540 + 0.862 + 1.288 \times \frac{350-200}{550} = +5.75\ m$

C point $= +4.540 + 0.862 + 1.288 + 2.139 \times \frac{900+350-550-200}{1{,}700} = +7.32\ m$

D point $= +4.540 + 0.862 + 1.288 + 2.139 \times \frac{500+900+350-550-200}{1{,}700} = +7.95\ m$

It is clear from the drawing that the water level at C point is slightly lower than the ground level and clearly above the ground level at D point.

From this fact, it is recoomended as an emergency measure as requested by Dhaka WASA that the water main at 1,500 m section from Hazaribag Lifting Pump Station should be replaced by pressure pipes and the existing pipes in this section should be connected to the inflow piping of Hazaribag Station to prevent possible pipe breakage on the route. Along with such modifications, the current lifting method by intermittent operations at downstream lifting pump station (New Market in this case; the same for the other stations) should be switched to continuous operations with a lowered water level at pump wells. The administrator should duly recognize the fact that, without such improvements, the effective use of sewer capacity can not be anticipated, let alone prevention of overflow from manholes.